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PC MAGAZINE

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SPECIAL PORTABLE COMPUTING ISSUE

PC LABS TESTS

80 PORTABLE PCs

- 66 Notebooks
- 14 Color Portables
- 7 Portable Printers
- 7 9,600-bps Traveling Modems

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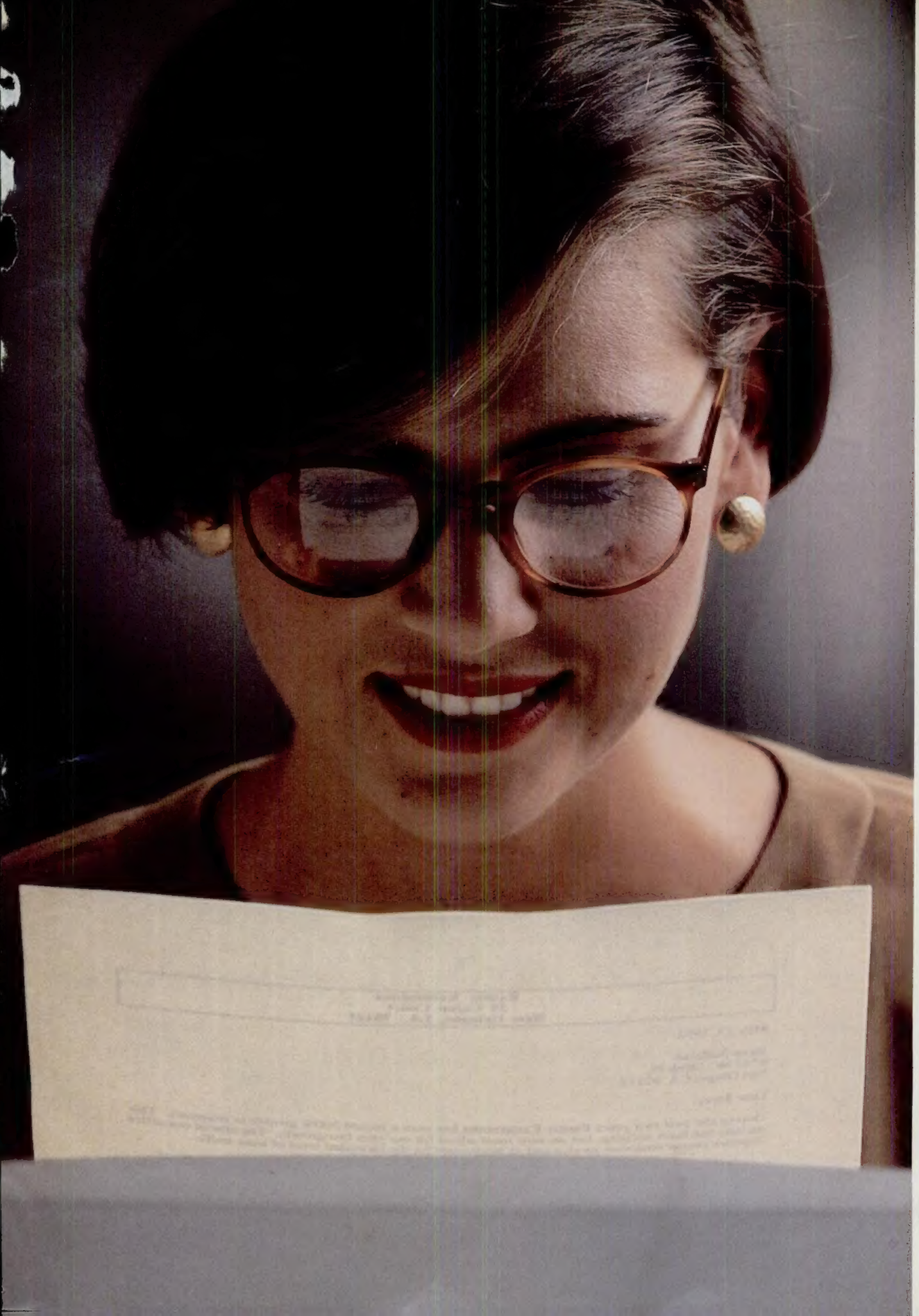

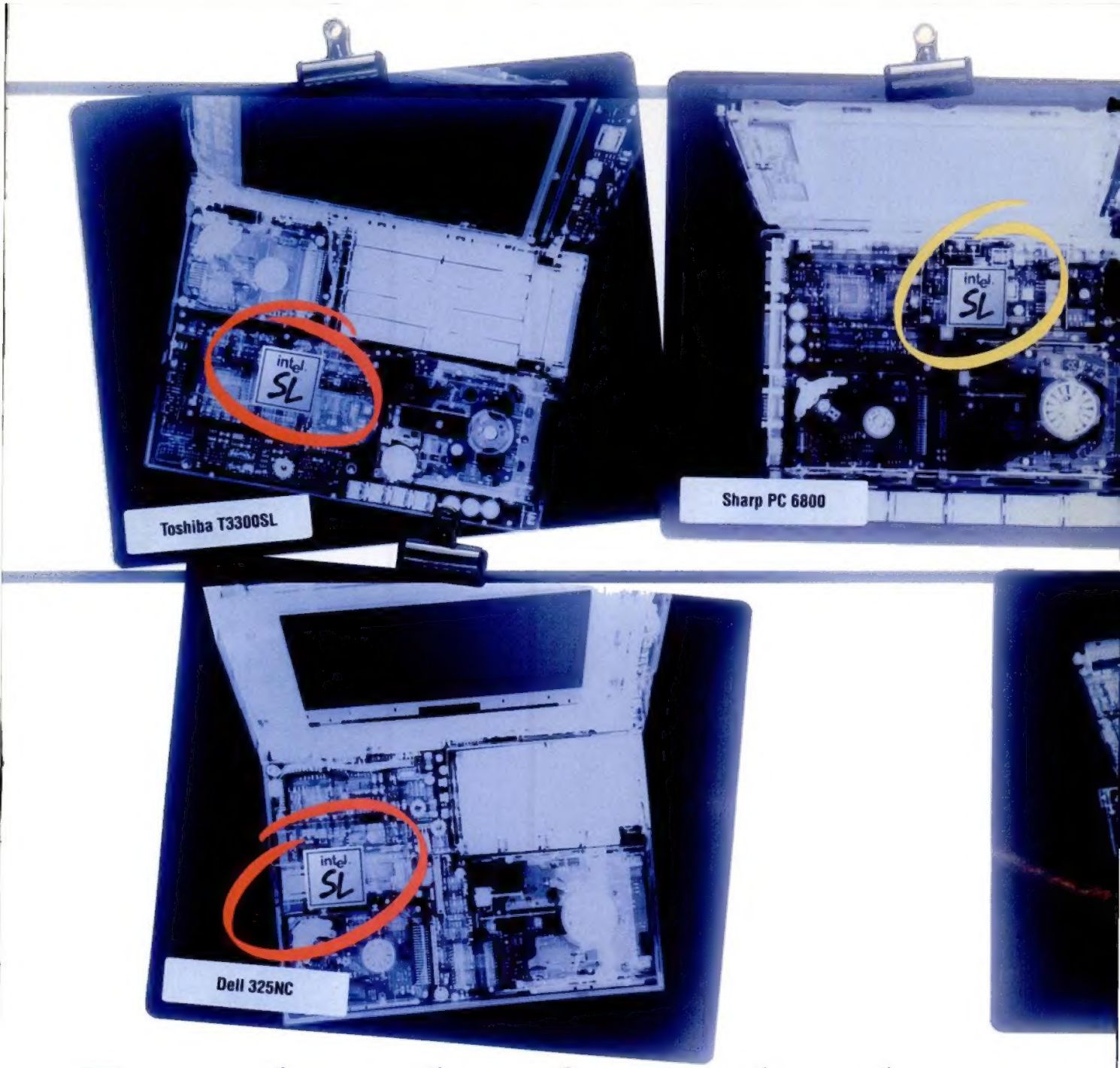

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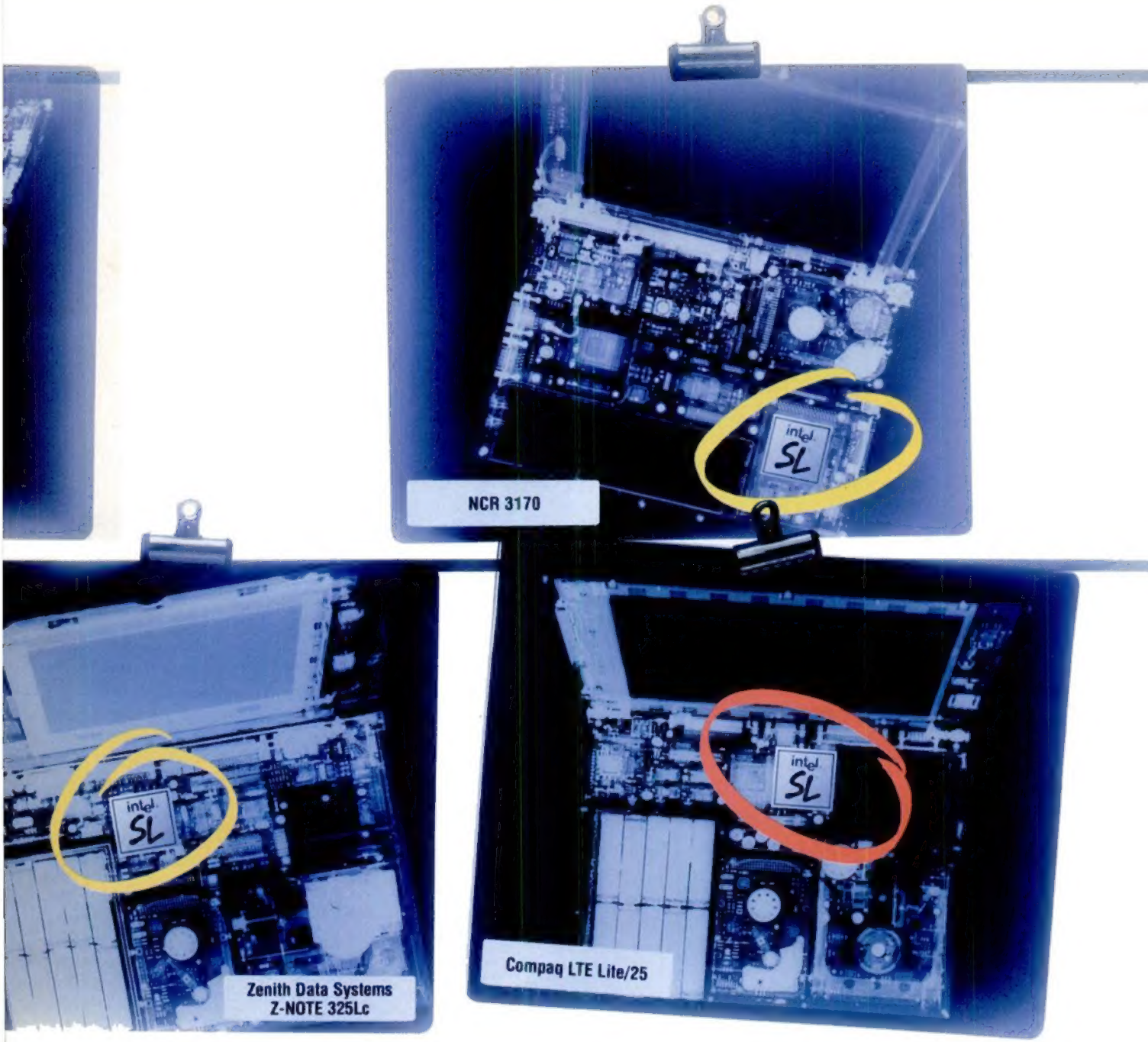

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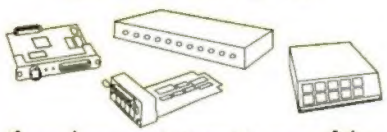

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Inside

You really do take it with you nowadays. Notebook computers have become the fastest-growing segment of computing in the last couple of years. The sight of a passenger hunched over in an airplane seat, pecking away at a computer, no longer draws stares from jaded travelers. For those of us who thought our 21-pound Kaypro IIs were incredibly luggable, a 6-pound notebook offers more firepower than we could have imagined a mere decade ago.

But as we've made gains, we've also grown more demanding of computer convenience. We want portable *everything*. Not only do we expect to write, calculate, or design on the road, we increasingly do it in color. We want to communicate from wherever we are, and we want to bring our printers with us.

This issue of *PC Magazine* should satisfy all the road warriors. We managed to cover an astounding 80 laptops, the most portable systems ever tested for one review by PC Magazine Labs. We also review fast portable modems and printers light enough to stash in your briefcase.

The PC reviews in this issue herald the debut of our new PCs team and a reorganization of the way we tackle PCs. Associate editor Matthew J. Ross moves from First Looks to manage PC reviews. Ross, a graduate of Brown and now in his fifth year at *PC Magazine,* trades places with Julie Cohen, who has been responsible for PC reviews since 1990.

PHOTOGRAPH BY LARRY FORD

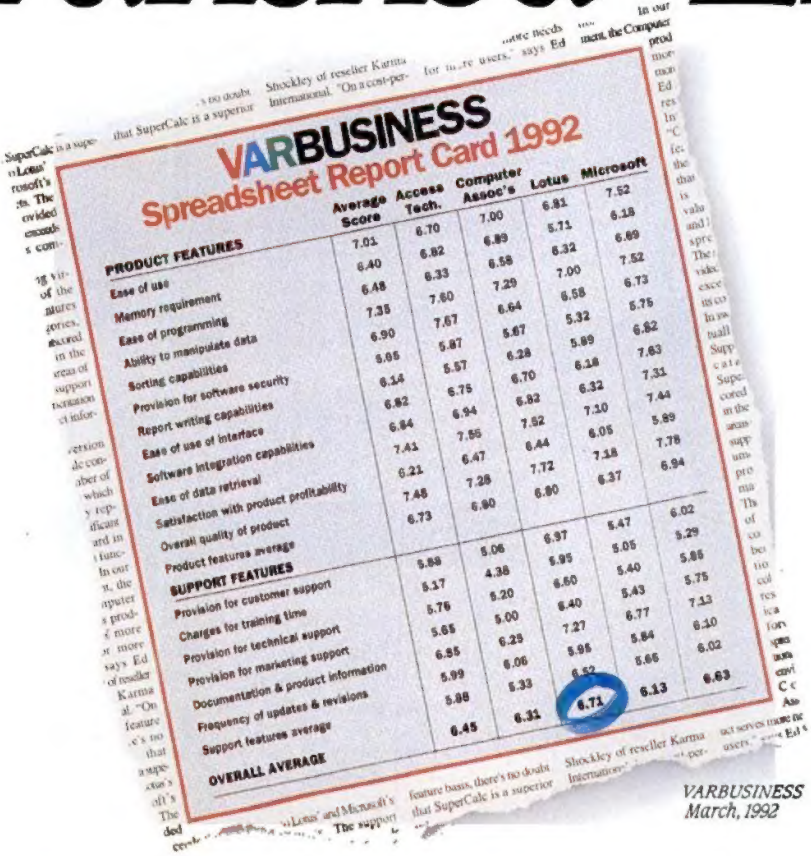
The PCs team: Ross, Rist, and Stoughton.

After years of using free-lancers to write PC reviews, we moved these assignments in-house in 1992 to improve our consistency and increase our coverage. PC Labs project leader Alan M. Stoughton is still responsible for the testing, but now staff writer Oliver Rist and a handful of our own editors and technical analysts write most of the reviews. Our new expanded labs and this new internal process increase the number of machines we can review. With the proliferation of brand names on the market, we're going to review all the machines we can to help you make wise choices.

—Joel Dreyfuss

PC Magazine: The Independent Guide to Personal Computing, ISSN #0888-8507 is published biweekly except in July and August for $44.97 for one year. Ziff-Davis Publishing Co., a division of Ziff Communications Co., One Park Ave., New York, NY 10016. Second class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Address changes to *PC Magazine,* P.O. Box 54093, Boulder, CO. 80321-4093.

Once Again, CA-SuperCalc's Numbers Crunched 'Em.



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Spreadsheet Report Card 1992

	Average Score	Access Tech.	Computer Assoc's	Lotus	Microsoft
PRODUCT FEATURES	7.01	6.70	7.00	6.81	7.52
Ease of use	6.40	6.82	6.89	5.71	6.18
Memory requirement	6.48	6.33	6.58	6.32	6.89
Ease of programming	7.35	7.60	7.29	7.00	7.52
Ability to manipulate data	6.90	7.67	6.64	6.58	6.73
Sorting capabilities	6.05	5.87	5.67	5.32	5.75
Provision for software security	6.14	5.57	6.28	5.89	6.82
Report writing capabilities	6.82	6.75	6.70	6.18	7.63
Ease of use of interface	6.84	6.94	6.82	6.32	7.31
Software integration capabilities	7.41	7.55	7.52	7.10	7.44
Ease of data retrieval	6.21	6.47	6.44	6.05	5.89
Satisfaction with product profitability	7.48	7.28	7.72	7.18	7.78
Overall quality of product	6.73	6.80	6.80	6.37	6.94
Product features average					
SUPPORT FEATURES	5.88	5.06	6.97	5.47	6.02
Provision for customer support	5.17	4.38	5.95	5.05	5.29
Charges for training time	5.76	5.20	6.60	5.40	5.86
Provision for technical support	5.65	5.00	6.40	5.43	5.75
Provision for marketing support	6.85	6.29	7.27	6.77	7.13
Documentation & product information	5.99	6.06	5.95	5.84	6.10
Frequency of updates & revisions	5.88	5.33	6.52	5.66	6.02
Support features average	6.45	6.31	6.71	6.13	6.63
OVERALL AVERAGE					

VARBUSINESS
March, 1992

This year's spreadsheet shootout is over. And like last year, the big winner is CA-SuperCalc.®

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According to the experts, it also outruns Lotus® 1-2-3® and Microsoft® Excel. What's more, Computer Associates' spreadsheet for DEC® users, 20/20, beat 1-2-3 as well, giving us two of the top four programs reviewed by VARBUSINESS.

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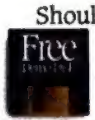

Shouldn't you be using the spreadsheet that beat the big boys? CA-SuperCalc. Number One in number-crunching.

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Small, Light, and Capable: Portable Printers Deliver A Triple Play

BY MITT JONES AND JENNIFER ZAINO Portable printers are helping make the portable office more of a reality today than ever before. Whether you're a frequent or occasional business traveler, you'll appreciate the compact size and quality text output provided by the seven printers reviewed here. You'll even find some whose paper-handling options make them as suitable for the desktop as they are on the road. **325**

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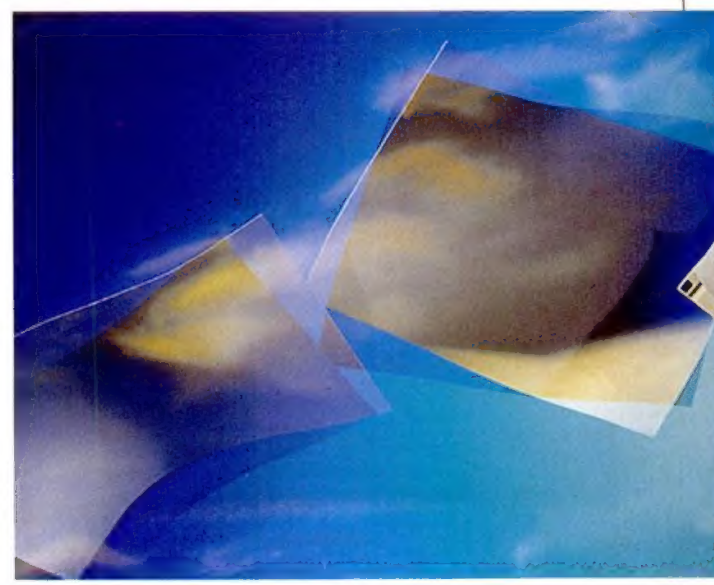

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Learn to play the piano—painlessly—with The Miracle Piano Teaching System, page 615.

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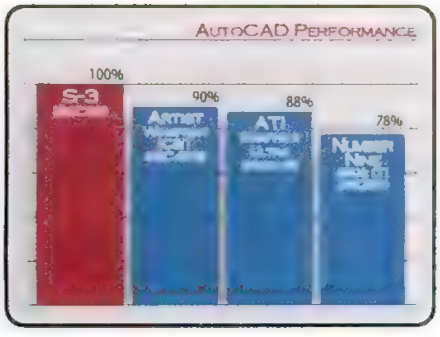

In PC Magazine's latest comparison of video chip performance tests running AutoCAD, the S3 based accelerators outperformed the competition, including the ATI Graphics Ultra, in all 10 categories except redraw where the TI 34020 took the lead.
Graph based on AutoCAD performance test results
PC Magazine 3-17-91.

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Subscription Rate: The subscription rate is $44.97 for a one-year subscription (22 issues). Canada and all other countries, please add an additional $32.00 for postage. GST Registration Number: R-123669673.
Back Issues: For back issues (subject to availability), $8 per issue ($9 outside the U.S.), send check or money order to Back Issues Dept., Ziff-Davis Publishing Company, P.O. Box 53131, Boulder, CO 80322-3131

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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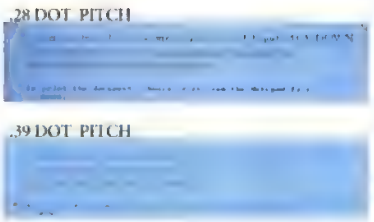

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intel inside

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PC Magazine Contributing Editor Winn L. Rosch

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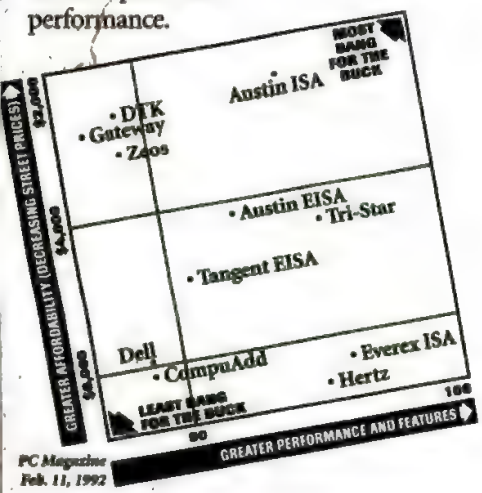

The performance/features axis of this chart is based on ten data points: the four benchmark test scores, installed RAM, disk capacity, VGA RAM, free slots, drive bays and extras (miscellaneous items such as free bundled software, mouse, on-site service, FCC Class B certification, extended warranty policy and flash EEPROM). A set of weighting factors has been applied to the raw numbers; you can find this data in the Ballwave Library of PC MagNet's Editorial Forum as 01BANG.WK1.

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2MB RAM (to 16MB)	2MB RAM (to 32MB)	4MB RAM (to 32MB)	4MB RAM (to 32MB)	4MB RAM (to 32MB
40MB Hard Drive	80MB Hard Drive	80MB Hard Drive	120MB Hard Drive	210MB Hard Drive
14" VGA 640x480 Color Monitor w/256k Video RAM	14" VGA 640x480 Color Monitor w/256k Video RAM	14" VGA 640x480 Color Monitor w/256K Video RAM	14" VGA 640x480 Color Monitor w/256k Video RAM	14" VGA 1024x768 Non Interlaced Color Monitor w/Windows Accelerator
1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives
101-Key Keyboard	101-Key Keyboard	101-Key Keyboard	101-Key Keyboard	101-Key Keyboard
DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse	DOS 5.0/Windows 3.1 Mouse
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486/DX2-50 VLI WinStation	486/50 ISA VLI WinStation	486/DX2-50 ISA VL WinStation	386/SX25 Notebook	386/SXL-25 Notebook
Intel i486DX2 running at 50MHz w/64K Cache (to 256K	Intel i486 running at 50MHz w/64K Cache (to 256K)	Intel i486DX2 running at 50MHz w/128K Cache (to 256K	386SXI running at 25MHz	386SXI running at 25MHz 4MB RAM
4MB RAM (to 32MB	4MB RAM (to 32MB)	8MB RAM (to 32MB.	2MB RAM (to 8MB.	210MB Hard Drive
210MB Hard Drive	210MB Hard Drive	60MB Hard Drive	80MB Hard Drive	9.4" VGA LCD Display,
14" VGA 1024x768 Non-Interlaced Color Monitor w/Windows Accelerator	14" VGA 1024x768 Non Interlaced Color Monitor w/Windows Accelerator	14" VGA 1024x768 Non-Interlaced Color Monitor w/Windows Accelerator	9.4" VGA LCD Display, 640x480 w/ 32 gray scale	640x480 w/ 32 gray scale Internal 2400/9600 bps Data Fax Modem
1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB & 1.2MB Floppy Drives	1.44MB Floppy Drive Built-In Tracker Ball	1.44MB Floppy Drive Built-In Tracker Ball
101-Key Keyboard	101-Key Keyboard	101-Key Keyboard	79-Key Keyboard	84-Key LexMark Keyboard
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Letters

THOU SHALT NOT STEAL

The theft of intellectual property through plagiarism, copyright infringements, or piracy of software is theft, pure and simple. John C. Dvorak's column ("The Software Piracy Bluff," May 12, 1992) appears to justify such theft because the victim is rich and unsympathetic. Simply because theft of software is practically undetectable and therefore immune from realistic prosecution in no way provides a moral justification for it.

Jerome C. Latimer
St. Petersburg, Florida

I'll bet John Dvorak has locks on his house. Does he complain if his own property is burglarized? The poor thief certainly had less money. I'll also bet the hair on the back of his neck would bristle if I stole his writings and claimed them as mine; the polite term is plagiarism.

D.H. Gaeddert
Georgetown, Kentucky

The National Association of Software Dealers to Non-Profits strongly objects to John Dvorak's philosophy of rip it off, the big publishers earn enough money. A lot of little guys get hurt, too!

Dvorak encourages using cheap alternatives; cheap, unsupported, and inefficient. People who sweat it out and make something useful are entitled to their profits and protection.

Kevin Duffy
New York, New York

I would like to thank John Dvorak for his exposé of the software industry's exorbitant price scandal. How many other industries can manufacture such an easily duplicated product for such a high markup? They probably make a decent profit on postage and handling alone.

Erick Herrington
Red Level, Alabama

PLATFORM PERSONALITIES

I bet the editors at *PC Magazine* are patting each other on the backs for the platform comparison cover story ("Platforms: How the PC Stacks Up," May 12, 1992). I would guess that a very small

John C. Dvorak
The Software Piracy Bluff

Is it right to steal from the rich and copy for the "poor"?

minority of your reader base could afford the machines that you profiled. What they need is a comparison review of systems in the $1,000 range.

Your magazine is for the MS-DOS population. It was absolutely no surprise that the 486 would come out on top.

Ed Krimen
San Francisco, California

In your cover story of May 12, there are no benchmark tests that put the PC through its paces as a Unix-based platform, comparative SPEC ratings are discreetly hidden away in the Macintosh article, and the only comparative reference to all-important file/database server performance comes under the Sun section, where "SQL databases . . . perform much faster than their PC and Mac counterparts." Get back to the high standards of quality in your comparative reviews!

Ivek I. Vinski
Jakarta, Timor, Indonesia

When I saw the cover of your May 12, issue, I was quite shocked that you failed to include the Amiga in your platform comparison. There are significantly more Amigas out there than NeXT machines, but your pie chart lumps Commodore's Amiga in the "other" category. I assume you know that the Amiga uses the Motorola 680XO chip family and owns a larger share of that pie piece than NeXT.

Douglas J. Nakakiara
Simi Valley, California

Until you guys realize that DOS is dead, Intel processors are inferior to Motorola's, Windows is a joke, and that clock speed is not the answer, you will never see that the Macintosh is the superior machine.

Tommy C. Barnes
Shreveport, Louisiana

MAKING A CLEAN GETAWAY

I agree with Bill Machrone ("The Great Windows Software Scandal," May 26, 1992).

Each software publisher insists through various licenses that users respect their property rights, but then they design programs that don't respect the users' right to control their own hard disks. The inequity is apparent.

In my opinion, *PC Magazine* would do the industry a very big service by insisting that every application fully and prominently document what it does to a hard disk.

Alexander MacN. Luke
Sag Harbor, New York

A bouquet to Bill Machrone for his column of May 26. Just in case I fall prey to the temptation to try Windows again, I hope *PC Magazine* creates a policy of not giving Editors' Choice awards to Windows programs that cannot install or uninstall themselves without messing up an entire system.

David Meredith
San Francisco, California

I think that *PC Magazine* should put its foot down again. Just as you refused to give an Editors' Choice award to copy-protected software, you should now refuse this distinction for applications that don't have an uninstall feature. During installation, users should also have the option to update their files manually.

Milton Laurie
Stamford, Connecticut

LETTERS

WHY DID THE DELL WIN?

After reading your June 16, 1992, review of 50-MHz systems ("486/50: The New Performance Leader"), I wondered why you even bothered to run benchmark tests. After performing a comprehensive range of tests, you gave the Editors' Choice to the Dell PowerLine 450DE, a machine that ranked second from the worst in your price/performance index, about average on the memory test, and significantly below average on disk and WINBENCH tests.

Since you did not explicitly list any objective, quantifiable factors that put the Dell ahead of the pack, I can only assume that some sort of hidden agenda was involved. In the future, please develop objective, comparative data on which to base your Editors' Choice.

Dean H. Anderson
Santa Barbara, California

In your recent comparisons of 486/50s, I found it amusing that, in selecting the Dell unit for Editors' Choice, you emphasized the importance of a "strong company behind it." Going corporate, huh? That didn't seem to be a factor a few short years ago when Dell was a fledgling company racking up Editors' Choice awards with computers half the price of those of the big boys. What about the companies that have units with the same or better performance than Dell?

Richard Johnson
Houston, Texas

The June 16 cover story weakens *PC Magazine*'s review credibility because the Editors' Choice was given to the Dell PowerLine 450DE instead of the Axik Ace Cache 486/WB/50. Your performance graph shows the Axik as the best choice for price and performance, while the Dell is shown as having medium performance and a high price. Pardon the pun, but the choice just doesn't compute.

Greg Gunther
Rolling Hills Estates, California

The Poly 486-50VF should have won, hands down. It beat the Editors' Choice, the Dell PowerLine 450DE, in almost every category. You even threw in a negative comment about buying the Poly: "Though you could choose a low-priced, high-bang-for-the-buck system like the Poly, we believe that if low cost is paramount, you should consider the clock-doubled 486DX2s now hitting the market." This sounds pretty lame-brained to me. If I can buy a top-of-the-line, high-performance PC for a very reasonable price, why should I do otherwise?

William L. Howard
New Bern, North Carolina

• Rarely is the cheapest computer your best bet—especially when you're shopping for a high-end PC. As our Editors' Choice box stated, we selected the Dell PowerLine 450DE for its superior construction compared with others in the group, its EISA bus, its FCC Class B rating, and our readers' confidence in Dell for its reliable systems and top-notch service and support. This class act was available at about two-thirds the price of the Compaq Deskpro 486/50L.—Ed.

Windows may be the most egregious example of consumer hysteria since the great Dutch tulip-bulb panic of the seventeenth century. Are we being coerced into buying it?

MORE THAN JUST A PRETTY FACE

I just finished reading "The Visual Development Environment, More than Just a Pretty Face?"(June 16, 1992). Sorry, but I think you viewed the technology with blinders on! Those of us who feel like we have been developing commercial software since the beginning of time, on just about every platform invented, have anxiously awaited the day when the pains of writing procedural code, Windows or not, would disappear. Yet you perpetuate the agony by insisting that a VDE offer "full-featured programming." The last thing we want is a "Visual C++," as you suggest in the article.

Your editors insisted on evaluating only "fully integrated, one-stop solutions." Knowing what we know now, that is asking vendors to perform the impossible. Let vendors specialize in parts of the whole. Stop the duplication of effort, don't encourage it! No wonder you had so much trouble trying to review these products. I would have preferred seeing you document the unique features of each product rather than trying to select an Editors' Choice.

Richard J. Hippert
Winter Park, Florida

MICROSOFT MONOPOLY

So now we have to pay a Gates subsidy to buy a computer. Look at the ads in your magazine: "MS-DOS and Windows 3.1 installed, Microsoft mouse included." Suppose you don't want Windows, or want to use DR-DOS, or already have a mouse? Can you buy a computer without all the Microsoft products and have the price reduced? Not according to three manufacturers I talked to. One company said I could get its computer without Windows and a mouse but there would be no price reduction.

J.J. Adler
Ridgecrest, California

In a recent column in *The New York Times*, the comment was made that Windows may be the most egregious example of consumer hysteria since the great Dutch tulip-bulb panic of the seventeenth century. I don't care if people want to sacrifice efficiency for icons. What concerns me is the number of ads I see in *PC Magazine* announcing new software that seems to be available only for Windows. Are we who resist Windows being coerced into buying it against our wills?

William Harrington
Greenwich, Connecticut

DEALING WITH DISABILITIES

My son has epilepsy. Like many others with this ailment, he can spend only limited time in front of a monitor, since the refresh frequencies of most monitors (50 Hz to 60 Hz) are in the midrange of the frequencies known to induce seizures in epileptics.

Considering the limitation that current equipment places on my son and

All I really wanted to do was simplify my job.

So I bought Windows. I added extra RAM. I bought a bigger hard disk. I replaced my video card and monitor. I bought a half-dozen new programs, installed a mouse, configured the system, and as I sit here watching my spreadsheet crawl on my PC, I'm thinking to myself,

"This is making it easier?"

Then there's Macintosh. The only personal computer designed from the very first chip to work the way people work. That's why Peter Lewis of *The New York Times* wrote the Macintosh is simply "better than DOS or Windows." That's why *Byte* wrote, "If you use a GUI to keep your computing tasks sorted out, the Mac does it best..." That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.®

Macintosh from Apple.

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LETTERS

others subject to seizures, as well as the benefits to be gained by removing barriers to the handicapped, isn't it time that the industry moves quickly to eliminate this unnecessary discrimination? After all, this is what the Americans with Disabilities Act of 1990 is all about.

Philip P. Brown
Arlington, Virginia

IS IT SOFTWARE YET?

I have a pet peeve with all of the major computer magazines I've read. It concerns publishing reviews of software that is not available to the general public. I've noticed that editors love to be the first to hit the newsstands with new product reviews. This does a disservice to your readers.

I suggest you start a trend: No product will be reviewed until it is shipping. Readers would be better served by honest reviews about actual performance than by public relations hype about "planned features."

David R. Laws
Gaithersburg, Maryland

• Actually, PC Magazine always publishes hands-on evaluations of shipping software. We sometimes make an exception for a new product that we believe is of great interest, but such exceptions are rare, and are clearly marked as previews.—Ed.

DTP IS TOO SLOW

Your May 12 review of low-cost desktop publishing packages ("Personal Publishing Comes of Age") was interesting, but you failed to elaborate enough on one aspect of DTP packages that is critical for users in settings such as schools: the time it takes to print a document from various DTP packages.

In the future, please give more details on printing time in your reviews, and include a graph of the results.

Eugene Chambers
Fonthill, Ontario, Canada

I CAN'T GET NO...

Congratulations, *PC Magazine*. You've won the Milquetoast Award for Spinelessness in Publishing, based on the June 16 article, "Software Satisfaction and Support." Once again, you've wasted paper, space, and human effort to tell us what we already know, while totally neglecting the task of uncovering the slimy operators in the software industry.

Conduct another survey. You'll only need one question: "Please list the five software vendors and product names that represent your worst experiences involving software during the past 12 months. For each vendor, also check boxes that describe the problem. . . ."

Doug Kanter
Rochester, New York

NETWORK HISTORY LESSON

Very rarely do I feel compelled to add my two cents' worth, but this is one of those times. After reading the Trends piece on PCs with on-board networking

I was amazed at how short the memory of some people can be. PCs with on-board networking are far from new! Digital introduced the VAXmate 10-MHz 80286 system in 1986.

(May 12, 1992), I was amazed at how short the memories of some people can be. PCs with on-board networking are far from new!

Digital introduced the VAXmate in 1986. For those who don't remember, it was a 10-MHz 80286 system that incorporated CPU, memory, monitor, floppy disk, and a built-in thin-wire Ethernet controller in a single cabinet.

While some didn't take the VAXmate seriously because of its nontraditional packaging, it was designed as a network-ready desktop, right out of the box.

Digital also currently produces a PC-based workstation, the DECpc 433W, that has on-board Ethernet or Token-Ring controllers.

Roger W. Starr
Ft. Washington, Maryland

HOW THICK IS TOO THICK?

I have an idea. How about printing all of your pages on heavy stock? Then we magazine readers could thumb through the magazine like old times.

Richard N. Lund
Munster, Indiana

• If *PC Magazine* were printed on heavier stock, it would be much thicker, much heavier, and more expensive, too. You might like the idea, but your mail carrier and your bookshelves would both start to sag.—Ed

X MARKS THE SPOT

Your recent article on DESQview/X (First Looks, June 16, 1992) correctly says that X is unusual among desktop windowing systems because the base system incorporates neither a mechanism to permit the user to manipulate windows nor a specific interface style. But the article confuses these two missing features.

It's true that X doesn't specify the look and feel of other applications; the system is defined as a low-level protocol for drawing lines, displaying text, and so on. The confusion may arise because in X, only a single client, if present, may typically be used to move or resize application windows, or reduce them to icons; there are several popular windows managers, including ones that implement an Open Look or Motif interface. Many systems, including DESQview/X, ship with these window managers by default; the clients may be mistaken for a built-in part of the system, but no inferences about the underlying architecture should be made.

David Lewis
Winchester, Massachusetts

MAKE WAY FOR THE TRASH

Big deal! So a few companies recycle printer and toner cartridges (Trends, June 16, 1992). What about our outdated manuals and books? With software companies upgrading or updating their products every 24 hours, more and more landfill space is wasted by manuals and user guides. Or do these companies expect us to hang on to these now useless volumes? Maybe they should send lovely oak bookcases with each new upgrade. I could use a few.

Steve Henderson
Long Beach, California

I FEEL LIKE I'M BEING PECKED TO DEATH BY DUCKS.

At $149.95 per PC, Windows sounded like a deal. Then I bought all new programs at about $500 a pop. I shelled out a couple hundred per machine for extra memory. I ponied up $300 each for networking cards. The mouse ran $100 and a bigger hard disk ran $275. And as I stare at the invoice for what it's going to cost me to connect them all together, I think to myself,

"THIS IS MAKING IT EASIER?"

Then there's Macintosh. There are no hidden costs. There are no cards to buy for networking, file sharing, sound, video or peripheral support. That's why *Computer Shopper* magazine said, "Let's not be coy: If you want the best GUI money can buy, get a Macintosh." That's why *MacWeek* said, "Apple has shown that it can be technologically brilliant and price competitive at the same time." And that's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* There's no personal computer on earth quite like it. And none more imitated. The affordable, compatible, connectable Macintosh personal computer. The power to be your best.®

Macintosh from Apple.

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LETTERS

BACK TO THE BASICS

Thanks for the article "Something Old, Something New: PC Magazine Looks at Nine DOS Word Processors" (May 26, 1992). Straight word processing was the main reason I bought a computer. It's nice to see you realize not everyone has either the hardware or the desire to run Windows.

David Phelps
St. Louis, Missouri

MAIL DOMINANCE

"How Reliable Is Your PC Vendor?" (the cover story of May 26, 1992) confirmed what I and many others have believed for some time now: Anyone who is in the market for a new computer can, with a little research, get a better deal by buying directly through a mail-order vendor than from an in-store dealer. In fact, I think I am going to make a photocopy of this article and shove it down the throat of the next condescending salesperson I encounter.

Terry W. Sloope
Kennesaw, Georgia

DOES IT REALLY COST THAT MUCH?

PC Magazine does its readers a tremendous disservice by quoting inflated list prices as it did in the tape backup feature ("Minicartridge Tape Backup: Simple, Inexpensive, and QIC," April 14, 1992). When discussing real-world solutions, you should be consistent by researching and quoting street prices. The result of using list prices is that your readers may infer that a given technology is out of reach, when the actual purchase price may make a dream affordable.

Gary Schwartz
Garden City, New York

THE BOTTOM LINE ON ELECTRONIC MEETINGS

The Trends article on electronic meetings ("Meetings Go Electronic, for a Price," May 12, 1992), did a number of disservices to the software discussed. You seem to balk at the price, but consider the economics. A meeting using GroupSystems, TeamFocus, or VisionQuest cuts meeting time in half, saving 50 percent in direct staff costs for a single meeting. I was glad to see you mention this category, but I am very disappointed with your casual treatment of it.

Jeff Truelsen
Ithaca, New York

I WANT MY LBV!

I have been watching local bus technology slowly enter the PC market. At last count there were about half a dozen companies that were advertising local bus systems. I am interested in the relative performance of local bus video compared to the latest Tseng- or S3-based Super VGA cards. Has anybody in PC Labs tested these systems? The impending onslaught of local bus technology cries out for an article on this issue.

James G. Monahan
Ladson, South Carolina

• *PC Magazine* did a First Look evaluation of NEC's local bus PC in the May 12, 1992, issue. We plan to take an in-depth look at video, including local bus technology, in an upcoming issue this year.—Ed.

IT'S NOT ALL BLACK, WHITE, BLUE, AND GREEN...

In your image compression article ("Something Lossed, Something Gained: Image Compression for PC Graphics," April 28, 1992), *PC Magazine*'s statement that "mapping high frequencies to a small range incurs less of a quality penalty than doing the same with the middle frequencies, because most humans have more trouble differentiating among high-frequency colors (blues) than middle- or lower-frequency colors (green)" is somewhat misleading since the "high frequencies" involved here are those related to edges and small details in the image. They have nothing to do with blues or greens.

Decio Fonini, Jr.
Rio de Janeiro, Brazil

NECESSARILY PORTABLE

The majority of people buy a laptop to increase productivity while away from their office or home machine. As a field biologist in Canada's Yukon, a university lecturer in Ghana, or a computer consultant in Indonesia, I need a decent computer—not just for a few days on the road, but for a year or more. Laptops have always been a step behind desktop systems in speed and features, at twice the price. Now they're finally starting to catch up. Hopefully, the industry and columnists will realize that powerful laptops aren't just pretty gadgets; for some, they are long-awaited necessities.

Roger Gruys
Spirit River, Alberta, Canada

CORRECTIONS & AMPLIFICATIONS

In "LAN Fundamentals, Part 2" (April 14, 1992), we incorrectly stated that LANstep originated with Waterloo Microsystems. Also, LANstep supports Windows in all modes and allows DOS workstations to share printers.

In "Consumables That Won't Consume Your Budget" (May 12, 1992), the price listed for Intuit Corp.'s Multipurpose one- to three-part forms may be misleading. That price is for sets of three-sheet colored forms that will print as a three-part set. One-part multipurpose forms are $62.95 for 500 and $84.95 for 1,000.

In "3.5-Inch Rewritable Optical Drives: Ready for Prime Time?" (May 26, 1992), the TenTime series of adapters is actually made by Phoenix's Laura Technologies.

Telebyte Technology's phone number (New and Improved, June 16, 1992) is 516-423-3232.

In "486/50: The New Performance Leader" (June 16, 1992), the Summary of Features incorrectly stated the length of the Axik Ace Cache 486/WB/50 warranty. The warranty runs for 13 months.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments, insights, and suggestions. Please send your correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016, or upload it to PC MagNet (see page 12 for access information). All letters become the property of *PC Magazine* and are subject to editing.

Sitting in coach between
two sumo wrestlers,
I pull out my laptop and try to get
some work done. I futz with the clip-on
trackball. Untangle the cord. Meanwhile,
my screen flickers at me like a dim bulb.
I notice the guy across the aisle is
struggling with a mouse, trying to use
the back of the seat as a mousepad.
And I think to myself,
"This is making it easier?"

Then there's Macintosh PowerBook. The one notebook designed from the beginning for anywhere/anytime computing. The trackball is built into the keyboard. Palm rests make it extraordinarily comfortable to use. That's why *Byte* said, "These new Macs with their ability to read DOS floppy disks, transparently connect to an office's AppleTalk network, and print to fax, make on-the-go computing easier and more productive than ever." That's why PowerBook was the only personal computer to make the Product of the Year lists of *Business Week*, *Fortune* and *InfoWorld*. And the only notebook computer to be named one of the Best Designed Products of the Year by *Time*. That's why J.D. Power and Associates ranked Apple the #1 Personal Computer Company in Customer Satisfaction Among Business Users.* The affordable, compatible, connectable PowerBook personal computer. The power to be your best.

Macintosh from Apple.

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THE ZEOS '486 EISA

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—PC Week

"The ZEOS '486 offers the best choice of all."
—Computer Shopper

"Outstanding."
—PC Magazine

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ZEOS 486-33 PC MAGAZINE EDITORS' CHOICE 4-16-91

ZEOS 486-25 PC MAGAZINE EDITORS' CHOICE 6-25-91

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In awarding your new ZEOS '486 the coveted *Editors' Choice Award, PC Magazine* said the ZEOS '486 EISA was "best on our tests." They went on to note the ZEOS '486 is "both surprisingly useable and affordable." But that really shouldn't come as a surprise. After all, this ZEOS '486 powerhouse comes from a family of *nine* ZEOS Editors' Choice machines. Now let's talk real '486 power:

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But what about compatibility? While the '486 processor offers full software compatibility, the EISA bus will accept your present eight- and sixteen-bit expansion cards and runs them without a hitch. That's the advantage of the EISA bus. Incredible performance with complete compatibility. That's your new ZEOS '486 EISA.

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And, speaking of performance. In their *Editors' Choice* review, *PC Magazine* noted "ZEOS has a reputation for tweaking and refining that shows." That's the ZEOS way. Attention to detail really makes the difference. We're talking about important details, items you may not even notice at first. Like two cooling fans in EVERY ZEOS '486. And cabinets *loaded* with drive bays. Loaded too with our high-capacity power supply and a motherboard that will take up to *32MB right on board.* And more.

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CIRCLE 157 ON READER SERVICE CARD

How Q&A Answers The Puzzling Questions Of A Growing Business.

The story of one company's rise to major success with the help of the world's friendliest database.

"When we started MindBusters Puzzle Company, life was simple. But we were quickly swamped with orders, phone calls, and inventory problems. Our puzzling business was a few pieces short of complete.

Fortunately Arthur, our business consultant, recommended Q&A as an easy-to-use database that would help us manage our growing business, without losing us in a maze of complexity.

Show me a list of sales made on April 7th by region.

With the Intelligent Assistant,™ just type your request in plain, everyday English. You'll see the answer in seconds.

He wasn't kidding when he said it was easy—we set up our first database in minutes. Q&A's unique Intelligent Assistant™ makes it the only database that lets you ask questions about your data in plain, everyday English. So in a flash, we got the answers we needed.

Next, we tackled a mailing to our customers. Q&A's built-in word processor and menu-driven mail merge process made it a snap to create 1,000 personalized letters and address labels. Because we didn't have to figure out how to make our database and word processor work together.

PC MAGAZINE EDITORS' CHOICE 12/17/91

Now you can produce personalized mailing labels and letters—in record time.

To set up our sales order and inventory tracking systems all we had to do was type an entry form on the screen to create the file. In just one day, Q&A had given us such control over our business, we knew we'd be ready for anything.

And we were. Our *Mr. Mystery Maze* sparked a nationwide puzzle craze that pushed sales to a record high. Because of Q&A's simple, intuitive design, our new assistant was up on it in no time—without training. Soon, he had customized Q&A to post sales and payments to vendors, generate invoices, and print out reports.

Before we knew it, we had six regional offices—all set up on Q&A. But some of our new employees were used to other types of software. Good thing Q&A imports and exports data from the most popular spreadsheet, word processing, and database files.

When we expanded, Q&A grew with us. We put it on the new network, so everyone could share the same data—at the same time. Sales could track new leads, while Manufacturing looked at the same data to determine inventory needs. All the while, we had 15 operators feeding new orders into our Q&A database.

When you think about it, Q&A solved our company's biggest riddle: how to grow from a small, very puzzling business to a major purveyor of puzzles. It really helped us put all the pieces together."

See for yourself why Q&A has become the #1 database for small businesses. Visit your dealer now, and begin your own Q&A success story. Call **1-800-228-4122, ext. 179-P** for a FREE demo disk. For a FAX Data Sheet, call **1-800-554-4403** (select option 1, document 100). Users of Q&A version 3.0 or lower can upgrade to Q&A version 4.0 by calling **1-800-228-4122, ext. 101.**

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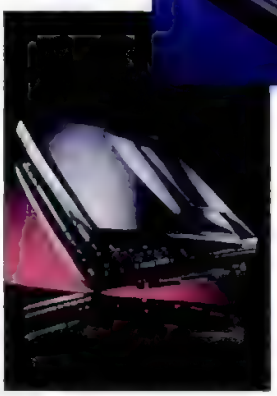
CIRCLE 344 ON READER SERVICE CARD

More Gucci than Gauche

Fashion comes to portable computers

Clamshell. Lunchbox. Pizza box. Portable computers have many nicknames, few of which are flattering. But there is no law that says portables have to be ugly. AT&T learned that two years ago when the Safari's outstanding design made it stand out in a crowded market. In the latest Silicon Valley designs, form usually follows function—like the trackball on Apple's PowerBook. And DOS-to-go portables are finally breaking the mold with Cinderella systems from BCC and Dolch.



Dolch's M.A.C.H. (above) and BCC's Avanti 025 break the mold.

Dolch's M.A.C.H. (Modular, Adaptive, Computer, Hardware) line, due by the time you read this, is as sleek as a jaguar next to Dolch's P.A.C. lunchboxes, whose burly builds aren't at all out of place on a construction site. The M.A.C.H., however, is formal enough to grace even the stuffiest executive boardroom.

The M.A.C.H. is not simply shallow good looks. Designed by Barry Wingate of Los Gatos, California (he was formerly with Frogdesign, the industrial design firm that gave Macintosh and NeXT computers their unique styles), the M.A.C.H. is functional as well as stylish. The M.A.C.H. is expandable through bolt-on hardware slices that let you add a slot at a time. A 1-inch slice handles standard adapters, while 2-inch slices take a CD-ROM drive, removable hard disks, or Bernoulli drives.

Wingate designed the M.A.C.H. to "incorporate aesthetics and engineering," he said, and covered the case with a rubberlike material, used in the automotive industry, that ruggedizes it. Inside, the M.A.C.H. is liquid-cooled, and a temperature-controlled fan kicks in when it encounters Death Valley conditions.

Notebooks can benefit from a makeover, too. BCC's Avanti 025, designed by GVO Inc. of Palo Alto, California, uses a special sliding hinge for the screen that actually lets you open and use the Avanti 025 on an airplane without slamming the top of the screen into the seat in front of you. The hinge, first pioneered in 1990 by GVO for the GRiD 1450sx notebook, slides the bottom of the display toward you. In order to keep it

Continues on page 34

Mail-Order PCs Still Tax-Free

"THIS IS A GREAT VICTORY," DECLARED the Direct Marketing Association when the Supreme Court ruled against states that wanted mail-order firms to collect taxes on sales to out-of-state customers (*Quill v. North Dakota*). But at least one direct marketer wasn't celebrating: Dell Computer Corp. "It would have been to our advantage," says Dell spokesperson Roger Rydell, "if the decision had gone the other way." Unlike most PC mail-order companies, Dell charges taxes to customers in many states. "We're more than just a catalog company," explains Rydell. "We offer a wide array of services and support."

The battle between the states and mail-order companies isn't over yet. The Supreme Court also ruled that Congress has free reign to decide the issue. "Leaving it up to Congress is appropriate," says Jim Bauer, senior vice president of Swan Technologies, which does not charge out-of-state taxes. "If Congress decides to tax mail-order sales, they can do it fairly. But if we had to do it now, the logistics would put some companies under."

How Congress will balance the concerns of budget-strapped states and in-state retailers versus those of mail-order firms and cost-conscious consumers is anyone's guess. What's likely is that Congress won't rock the boat this (election) year.—*Mary Kathleen Flynn*

Apps Migrate to Windows NT

IBM BEAT MICROSOFT TO MARket with a 32-bit operating system, but Microsoft is determined to outdo Big Blue when it comes to providing a critical mass of 32-bit applications for its 32-bit operating system. Windows NT won't ship

Pipeline *By Gus Venditto*

Have PC Prices Hit Bottom?

Have PC prices gotten as low as they can? It's clear that the market will not tolerate premium prices no matter how advanced the technology or trusted the name. That's all well and good for consumers, but the cutthroat competition that's raging raises the disturbing notion that a market correction could be coming soon. The clearest sign that we may be bottoming out is the trouble that leading PC makers have had recently.

Compaq's declining market share forced the company to come up with a whole new line of less expensive PCs. IBM's difficulty in maintaining high prices has led it to a series of new measures, including selling PS/2s direct for the first time and developing plans for a low-cost line of PCs under a new name.

Finally, Everex's purchase of Northgate was the most revealing development of all. After years of constant growth, Northgate was on a path that would make it as large and influential as Dell. But Northgate posted large losses in recent quarters and was sold for the fire-sale price of $4.5 million. While Northgate's reversal of fortune is due to several factors (including the expense of developing a corporate sales force), Northgate went offtrack when its prices started rising.

PHOTOGRAPH BY PETER GREGOIRE

Some believe that similar troubles await other companies, that there will be a series of consolidations, and that prices will start to rise in a smaller market.

I don't think that will happen. It's impossible to predict the individual fortunes of any one company, since so many factors come into play, but today's climate of bargain prices is almost guaranteed to continue for a good while longer. The most telling sign of this is that new companies continue to enter the market, and precious few start life with the goal of building a premium name. It's still common for a small group of people to raise a small amount of capital and start selling low-cost PCs in a matter of weeks.

The factor that will guarantee the continuation of low prices is the proliferation of new processors. In recent years, a good relationship with Intel was essential to market leadership; today and tomorrow, it's more important to be listening to customers and building the machines they want.

There will be some casualties: those companies that try to dominate a market segment. The future will belong to the nimble, the companies that can deliver a wide range of PCs. The future will not be kind to companies that try to live on their names alone.

Gus Venditto is editor of PC Sources *and a contributing editor to* PC Magazine.

PHOTOGRAPH BY RICH ANDREWS

Microsoft's Robert Hess (left) and Wall Data's John Lemire port applications to Windows NT.

until year's end at the earliest, but Microsoft is already boasting 50 32-bit applications that run under it.

The Windows NT Portability Lab is a key component of Microsoft's developer relations strategy. Approximately 40 companies have already visited the lab, which is designed to help developers transform their 16-bit apps into 32-bit apps. Robert Hess, a software design engineer in Microsoft's developers' relations group, expects many more companies to take advantage of the facility after the Win32 Professional Developers Conference in July. Currently, the lab consists of 6 stations (including two MIPS machines), which Microsoft plans to expand to 17.

Wayne Warren, vice president of research and development at Raima Corp., was one of the first developers to work in the lab when he began porting Raima Data Manager to Windows NT. He says the lab gave him "immediate access to the Microsoft programmers. These guys have the answers." John Lemire, a product development manager at Wall Data who used the lab to port Rumba 3270 to Windows NT for a demo at Spring Comdex adds, "Working in the lab let me focus fully on NT and not get distracted."

For both developers, the porting process was a positive experience. Both agreed, however, that the editor and the debugger could have been better. Microsoft's Hess pointed out that those tools would be improved in time for the preliminary version of the Win32 Software Development Kit (SDK), which Microsoft is distributing at the July developers' conference.

One important tool that won't be ready until a future release of the SDK is Win32s, a subset of the Win32 API that will allow developers to write 32-bit applications that can run under both 16- and 32-bit Windows. Borland also expects to add this capability to its development tools.—*Mary Kathleen Flynn*

In-Flight E-Mail

AIRLINES WILL OFFER IN-FLIGHT modems as part of the furniture beginning this fall. The first airline to test the service, USAir, will use the FlightLink service provided by In-Flight Phone Corp. on selected 757 airplanes. Another company, GTE Airphone (which currently has one-way air-to-ground service on American, Delta, and United Air Lines), plans to offer two-way GenStar service on some airplanes in 1993.

Current one-way service, which many planes now have, can't handle two-way (air-to-ground and ground-to-air) communications. For about $2 per minute, both services will be able to use standard communications software to send and re-

ceive faxes and e-mail and to log on to bulletin boards and information services.

FlightLink will require a special cable that connects your notebook's serial port to the FlightLink system, but you won't need a modem: It will use a 9,600-bps modem that is installed on the airplane. The signals will be sent from a 386-based server PC that will also be installed on the plane.

Both systems will use a digital system that communicates to ground stations across the country, so you won't be able to use the service more than 200 miles offshore. Future plans include satellite links that will extend the services worldwide.

Now that we'll have data ports, how about adding an AC outlet?
—*Christopher Barr*

Top Retail Software

Current ranking	Last issue	Product/ Company
1	3	**QEMM-386 6.0** *Quarterdeck Office Systems*
2	10	**Excel for Windows 4.0 Upgrade** *Microsoft Corp.*
3	5	**WordPerfect 5.1 for DOS** *WordPerfect Corp.*
4	1	**Microsoft Windows 3.1 Upgrade** *Microsoft Corp.*
5	2	**Microsoft DOS 5.0 Upgrade Kit** *Microsoft Corp.*
6	4	**Microsoft Windows 3.1** *Microsoft Corp.*
7	11	**Word for Windows 2.0** *Microsoft Corp.*
8	13	**WordPerfect 5.1 for Windows** *WordPerfect Corp.*
9	12	**Procomm Plus 2.1** *Datastorm Technologies*
10	—	**WordPerfect Windows Trade Up** *WordPerfect Corp.*
11	—	**WordPerfect Additional License** *WordPerfect Corp.*
12	9	**Stacker 2.0** *Stac Electronics*
13	14	**Word for Windows 2.0 Upgrade** *Microsoft Corp.*
14	—	**The Norton Utilities 6.01** *Symantec Corp.*
15	—	**Quicken 5.0** *Intuit*

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending June 6, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

Seed Money for Software Startups

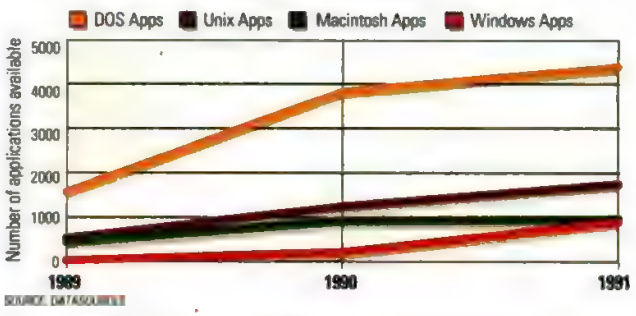
IF YOU'VE EVER DREAMED OF starting up a software company, now is a good time to dust off your business plan because venture capitalists, who have been cautious about investing in software startups since the early 1980s, are opening their wallets once again.

"There's no semiconductor investing done today like there was 20 years ago," explains Ann Winblad, a founding partner of Hummer Winblad (Emeryville, California), the first fund to focus solely on software companies. "The hardware market is largely commodities now, so software starts to look really good." Since the fund closed in 1989, Hummer Winblad has invested approximately $14 million in nine software companies, including Arbor Software Corp. (client/server–based applications), Central Point Software (PC Tools Deluxe), Powersoft (development tools for client-server apps), and Slate (pen-based applications). In addition to the $21 million still remaining in the original fund, Winblad expects to raise another software fund next year.

"There's renewed interest in software," says Kevin Fong, a partner at the Mayfield Fund (Menlo Park, California), "because we have new platforms—like Windows, which is still in its infancy, like client/server computing, personal digital assistants, and pen-based computers. All these new platforms mean opportunities for new applications." Earlier this year, the Mayfield Fund launched Mayfield Software Partners, a $4 million fund aimed at software startups in the "seed" stage. In addition to money, Mayfield Software Partners plans to provide each startup with a mentor, one of the fund's famous limited partners such as Broderbund CEO Doug Carlston or Metaphor founder David Liddle.

Money for new software companies is also available from funds that aren't focused exclusively on software. Technology Venture Investors (Menlo Park, California) still has $70 million left in its $115 million fund, one third of which is likely to go to PC software companies, says David Marquardt, a founding partner who was an early investor in Microsoft and is still on its board of directors. "The only time you can make money in the software business," explains Marquardt, "is when you have a paradigm shift. With Windows, mobile PCs, and the pen revolution, we've got a whole new playing field."

Software Surge



Venture capitalists are betting that today's new platforms (client-server computing, personal digital assistants, pen-based computers) will shake up the apps market as Windows 3.0 did in 1990.

"We never stopped investing in software, but we are doing more these days," says Jonathan Flint, a partner who specializes in software at Burr, Egan, Deleage & Co. (Boston). "Now is a terrific time because the march of technology has turned from a trot to a run," says Flint, who is the lead investor in Powersoft. Burr, Egan has approximately $50 million earmarked for electronics companies, which Flint expects will go mostly to software, data communications, and telecommunications companies. "We're a $500 million firm, but we're still very interested in backing two guys in a garage."—*Mary Kathleen Flynn*

Client/Server Apps Arrive

SHRINK-WRAPPED APPLICATIONS that use client/server technology are finally hitting the street. Although heralded as the next big thing in network databases, client/server applications are not easy to

develop. It's a far stretch from dBASE programming, which has long been the standard in PC database development. Developing client/server applications usually involves programming in C and SQL, and requires a knowledge of network architecture as well. As a result, most of the applications using client/server technology are developed for a vertical market, because the high development costs are only incurred when a sale is all but guaranteed.

That is changing. Horizontal client/server apps are beginning to appear. The Windows Support Group (212-675-2500) is shipping The Corporate Calendar, developed using Microsoft SQL Server. Lucas Management Systems (713-956-7511) is shipping Artemis Prestige, a project management program that was developed using Gupta's SQL Server engine and Microsoft Windows. Both of these programs offer all of the advantages of client/server technology. They are optimized for PC networks, they use Windows client user interfaces, and they store data in SQL databases that can be accessed from any compatible SQL front end.

—Rick Ayre

Write Once, Read Once Literature

MARSHALL MCLUHAN DIDN'T have *Agrippa (A Book of the Dead)* in mind when he said, "The medium is the message," but that was only because *Agrippa* didn't exist yet. Nowhere have the medium and the message been more closely intertwined than in this floppy disk–based novel that you can read only once, written by William Gibson, the daddy of cyperpunk.

Once-in-a-lifetime experience.

The text of *Agrippa* comes on a PC-compatible floppy disk with a built-in encryption program that erases the text and encrypts the disk after you've read the story. Also included in the package are DNA etchings by Dennis Ashbaugh (known for his paintings of computer viruses) that undergo irreparable mutations as they're exposed to light.

This ephemerality is all a part of the experience of the story, which deals with Gibson's memories of his father, who died when the author was six years old. These memories, like the technology that's being used to convey them, exist only as a moment in time.

"I like the idea that the technological platform will sink into the past," says Gibson. "In 100 years, people might have little squishy things that look like lumps of modeling clay that will read any kind of electromagnetic medium you wrap them around. I would imagine you have to get to a point where somebody will have a universal reading device."

This once-in-a-lifetime experience doesn't come cheap, though: The package is being published by Kevin Begos Publishing (New York, New York) in two limited editions, one priced at $450, the other priced at $1,500. The lower-priced edition buys you the *Agrippa* floppy disk along with reproductions of the Ashbaugh etchings, encased in a cloth box. For $1,500, you get a cast bronze box and original etchings. If you can't afford either, wait for the one-time broadcast this fall to as-yet undetermined bulletin boards and museums.

—Gayle C. Ehrenman

Briefs

IBM IS PUTTING ITS TOP EXECUTIVES ON (THE) LINE to discuss OS/2 as part of its effort to build a more direct relationship with customers. Between July 23 and 26, IBM will exchange e-mail with PC users on ZiffNet, an on-line service owned by the company that publishes *PC Magazine* (Type GO ZNT:GUEST or call 800-666-0330). If you miss that opportunity, you can call IBM's new HelpCenter for technical support (800-PS2-2227, from 8:00 to 5:00). But one way the new IBM won't communicate with you anymore is by answering reader service cards generated by editorial material in magazines like this one (although it will still respond to cards generated by ads).

"WHO CAN DO THIS BETTER THAN YOUR LOCAL PAPER?" queries former *Chicago Tribune* reporter Gene Quinn about his brainchild, Chicago Online, an on-line service that focuses on local content such as restaurant and movie reviews, hometown sports events, and politics. Quinn, now general manager of Chicago Online, teamed up with America Online and the Tribune Co., which publishes the *Chicago Tribune,* to develop an array of local services. Next stop: Orlando, where the Tribune Co. owns the *Orlando Sentinel.* (To order, call 800-922-0808.)

HALFTONE PRINTING GOT ANOTHER ENHANCEMENT when Destiny Technology Corp. brought out its new D9010 single-chip laser printer controller, which extends the company's Edge Enhancement Technology for text and line art to halftone images. Acer, Apple, LaserMaster, Xante, and XLI have also developed halftoning technologies over the past year (Trends, May 12).

—Mary Kathleen Flynn

More Gucci

CONTINUED FROM PAGE 31

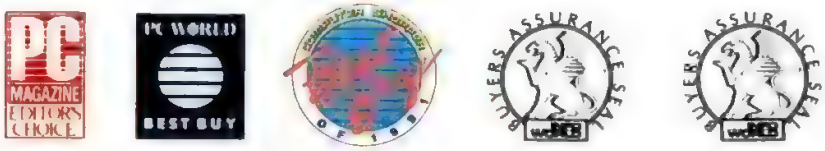
slip- and scratch-resistant, the Avanti 025 features a "soft-touch" finish to protect it.

GVO's Michael Barry expects innovations to show up first on portables rather than on desktop systems because portables "are more sensitive to the fashion world." Carrying a high-tech notebook is "a statement of how well I'm plugged into this technical world."

While being a slave to fashion usually costs you more money, Barry says, "It doesn't cost more to do a good design right the first time." Amen.

—Christopher Barr

The Magazines Rate ZEOS® Notebooks #1.



So Do Notebook Users.

Source: PC World survey of customers who own Notebooks, January, 1992.

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THE INTELLIGENCE OF THE 386SL CHIP.

Intel designed the new 386SL processor specifically for notebooks. And they were right on target! According to *PC Magazine*, this sharp new processor "promises to extend the battery life of portable PCs significantly, not by drawing less power but by being intelligent enough to power-down the memory, disks, modem, video and ports when they are not in use. The results can be impressive..."

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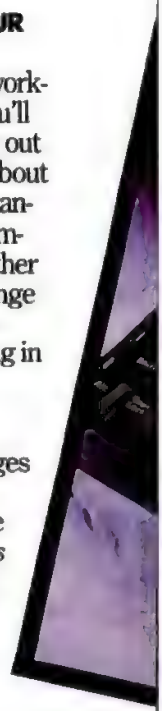

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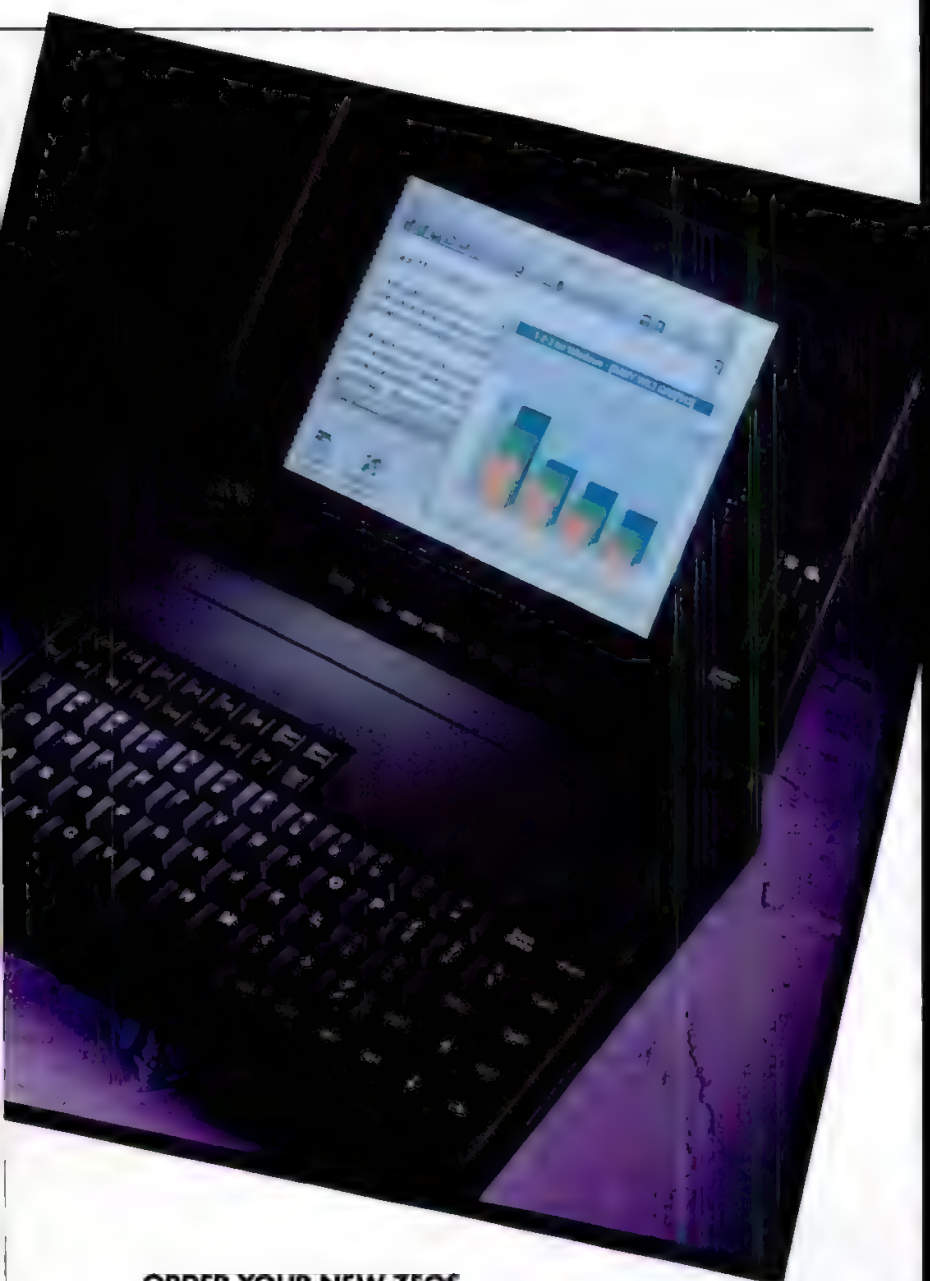

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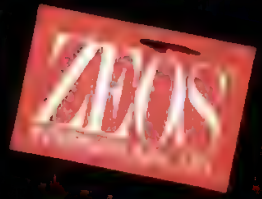

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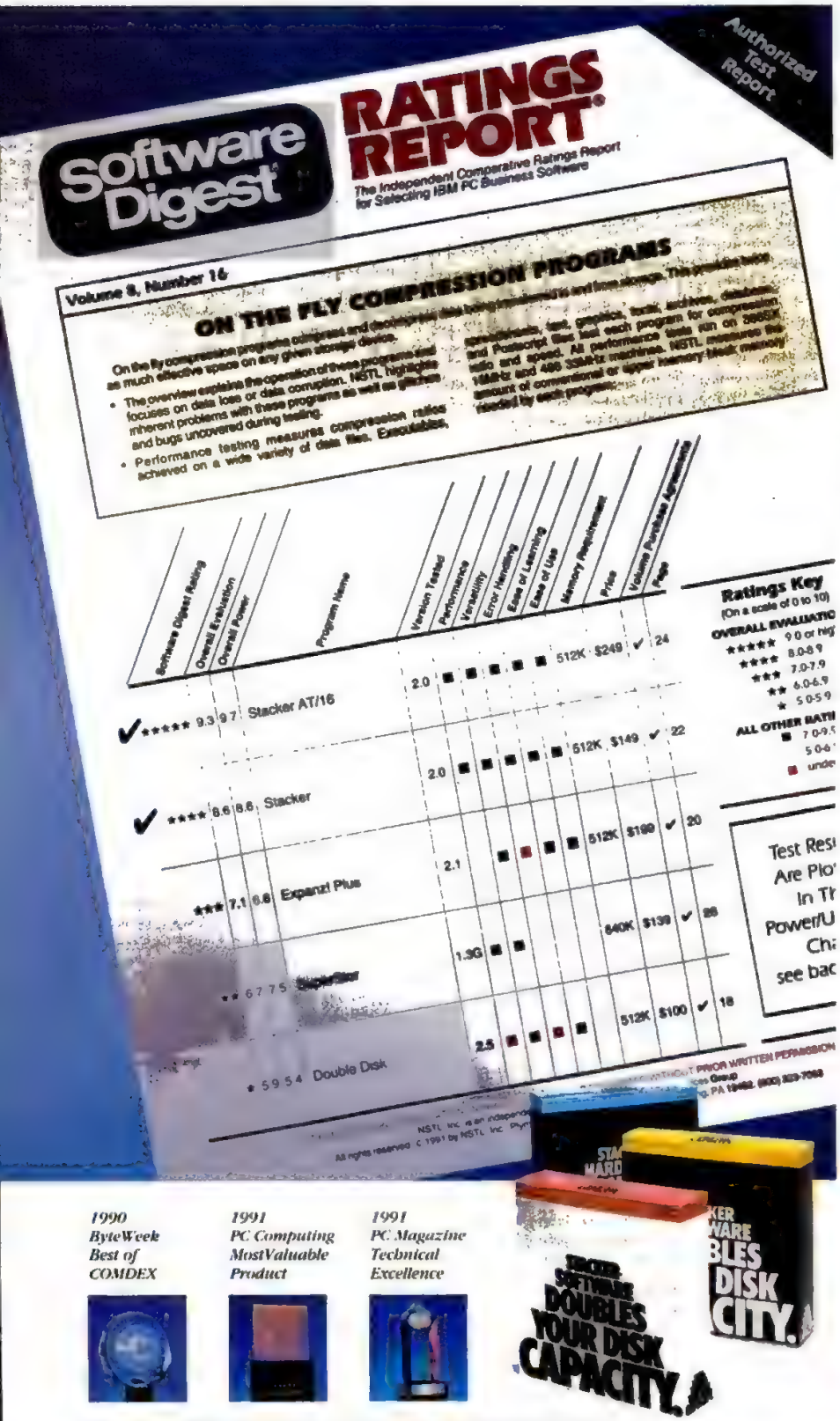

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First Looks

PowerPoint 3.0: New muscle for high-end presentations, 44
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Compaq, Librex, Samsung, ZDS

Newest Notebooks Offer Desktop Features

Removable hard disks. Built-in LAN adapters. Vivid color. That's what's new in the newest notebook PCs. We've evaluated five systems here that shipped too late to be included in this issue's portable PC cover story.

Compaq Contura 3/25

BY GREG PASTRICK

It is dark gray, features a rounded shape, and has a silly name, but it's a Compaq. The new-look Compaq Contura 3/25 notebook is part of Compaq's clone-beater strategy and packs an aggressive price/performance punch to startle mail-order competitors.

The 6.2-pound Contura is built around either a 20- or 25-MHz 386SL chip and is bundled with a color-matched side-mounting Logitech trackball. The $2,099 model we tested comes with the 25-MHz 386SL, 4MB of RAM, a 64K cache, a 60MB hard disk, a backlit LCD panel with 32 shades of gray, 512K of VRAM, and an expansion slot for the company's new line of under-$300 internal fax/data modems.

It's all packaged in a sculpted case designed to appeal to people with an affinity for Infinitis, but there's more to the machine than looks. It distinguishes itself with video performance that is far better than the average for 25-MHz 386SL-based portables. Its Graphics Winmark score of 1.78 also shows respectable graphics handling.

Processor, memory, and disk scores for the Contura are consistent with the average performance of others in its class. On our battery rundown test, the Contura's battery life was 1 hour 13 minutes less than the Zenith Data Systems Z-Note 325L Model 60's (see review), but at 2 hours 36 minutes, it's a reliable power supply.

On many counts, the Contura represents a shocking departure from Compaq's standard-issue family of portables. Fortunately, its perfor-

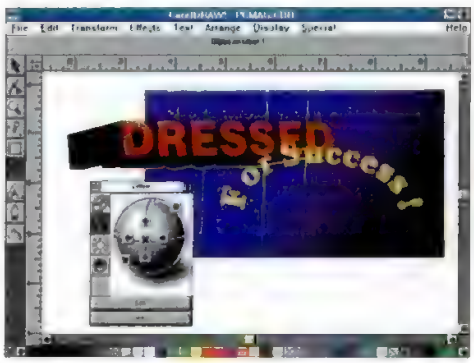
• *Continues on page 40*

Graphics

CorelDRAW 3.0: The Ultimate Graphics Bargain

BY LUISA SIMONE

CorelDRAW, Version 3.0, is the bargain of the year. For only $595, you get the now-classic vector drawing product, a charting program, a bitmap image editor, a standalone autotracing program, a file-management program, and a screen-show utility. The entire toolkit, which requires 23MB of hard disk space if fully installed, includes CorelDRAW, CorelChart, CorelPhoto-Paint, CorelTrace, CorelMosaic, and CorelShow.



ROTATION: *CorelDRAW uses Roll Up windows to give you easy access to complex drawing functions.*

The greatest star of this constellation is still CorelDRAW. The deceptively simple toolbox, which still contains fewer than a dozen tools, ensures that CorelDRAW remains the easiest-to-use graphics product on the market today. Longtime users of this product will be happy to hear that the toolbox has been tweaked to include both a freehand stylus and a Bezier curve stylus.

Other interface improve-

• *Continues on page 42*

Compaq Contura

CONTINUED FROM PAGE 39

mance is no surprise. With memory expansion up to 12MB and a 120MB hard disk option at prices that match or beat its competition, the Contura is a welcome and successful player in this crowded market. Even with its purple buttons.

• List Price: *Compaq Contura 3/25, with 4MB RAM, 60MB hard disk, $2,099; with 120MB hard disk, $2,499; Contura 3/20, with 2MB RAM, 40MB hard disk, $1,699; with 84MB hard disk, $1,999. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518.*

Circle 419 on reader service card

Benchmark Tests: Notebook PCs

Notable performers are the ZDS Z-Note 325L Model 60, with an exceptional battery life of 3 hours 49 minutes with its power-conservation features disabled, and the Compaq Contura 3/25, which turned in excellent video results.

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure the PC's processor, memory, disk, and video subsystem performance. The Graphics Winmark is the geometric mean of 12 Windows-based graphics tests from WINBENCH 2.5, weighted to reflect how frequently various functions are used.

	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	Graphics Winmark (megapixels per second)	Battery Rundown (hours: minutes)
ZDS Z-Note 325L Model 60 (386SL/25)	130	2,888	86	1,771	1.40	3:49
Compaq LTE Lite/25c (386SL/25 active-matrix color)	130	2,911	86	3,105	1.82	1:37
Compaq Contura 3/25 (386SL/25)	128	2,736	87	2,876	1.78	2:36
386SL/25 average	127	2,722	86	1,443	1.22	N/A
Samsung NoteMaster 386SXL/25 (Am386SXL/25)	117	2,111	92	681	0.86	1:38
Am386SXL/25 average	117	2,184	87	1,031	1.06	N/A
Librex T386SX (386SX/20)	96	1,843	78	1,970	1.37	1:57
386SX/20 average	91	1,762	87	1,018	0.95	N/A

N/A—Not applicable. PC Magazine Labs has not yet run the test on enough machines of this type to compute a meaningful average score.

Compaq LTE Lite/25c

BY GREG PASTRICK

The hype may focus on its color display, but the real appeal of the Compaq LTE Lite/25c is its solid integration of features and options. Not only do you get active-matrix color, but also more memory and a larger cache than in previous LTE Lites. The system also comes with an ingenious built-in trackball.

IN-COLOR: *Compaq puts active-matrix color on its new Lite/25c.*

At $4,999, the Lite/25c is still too costly for many. But for business applications that demand color, it's a bargain compared with the $5,999 NEC UltraLite SL/25C.

The base-priced model comes with 4MB of RAM, a 64K external processor cache, an 84MB hard disk, and a 256-color active-matrix TFT (thin film transistor) display with 512K VRAM. A model with a 120MB hard disk is priced at $5,399.

The Lite/25c did extremely well on our video performance tests. Its Graphics Winmark score is far better than that of its closest competitor, the ZDS Z-Note 325L. The Lite/25c's processor and disk measures are consistent with other systems in its class, but the Lite/25c beats the average for 25-MHz 386SL memory scores. Unfortunately, though, the power-hungry display helps to drain the Lite/25c's battery in 1 hour 37 minutes.

Amenities like the accurate pop-up power-drain gauge are useful, and the trackball is cleverly designed. It's really more of a "thumbmouse" mounted to the lower-right-hand side of the display, with the buttons placed on the back of the display. The clear, colorful screen can be readily seen from a wide range of angles, which makes the system workable as a portable presenter. The Lite/25c sets a new price point for active-matrix color portables, and it does so without compromising quality or performance.

• List Price: *Compaq LTE Lite/25c, with 4MB RAM, 64K cache, 84MB hard disk, active-matrix color display, $4,999; with 120MB hard disk, $5,399. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518.*

Circle 420 on reader service card

Librex T386SX

BY CAROL LEVIN

Design a slim, modular notebook, offer a PCMCIA slot and plenty of upgrade options, give it a good battery life, and you've got the $2,499 Librex T386SX. Best of all, it's not an ounce over 5 pounds and measures 1.5 by 11.5 by 8.5 inches (HWD). The Librex is stronger than most notebooks, and the rubberized case is slip-proof and scratch-proof.

Based on a 386SX/20 processor, the Librex cleverly hides several expansion compartments. The removable 40MB hard disk slides out easily for unlimited data storage and simple data security. The external bus connector for the external floppy disk drive is concealed on the left. Flip open a door below the Spacebar and you can feed in a RAM module ($299 for 2MB, $459 for 4MB, and $999 for 8MB); the Librex accommodates up to 12MB of RAM. The backlit display supports 64 shades of gray.

Librex Computer Systems is one of the first developers to implement PCMCIA, an I/O standard for credit card–size peripherals. You can slide in a fax/modem card

• *Continues on page 41*

Librex T386SX

CONTINUED FROM PAGE 40

($499) or a 1MB flash memory card. The single PCMCIA slot is both the Librex's best and worst feature, though: A PCMCIA system really needs two slots to be useful.

The notebook lacks the integrated power-management features of the SL chip, but its conservation features are well thought out. There's a "forced sleep" mode, a battery that lasted a respectable 2 hours, and an internal sub-battery that powers the system for 5 minutes while you replace the battery.

Compared with other 386/20s, the Librex performed about average on our processor and memory tests, lagged behind on our disk test, and scored among the top performers on our video and Graphics Winmark tests.

Though faster notebooks at this price are plentiful, the clever design, PCMCIA slot, and removable hard disk put the lightweight Librex T386SX at the forefront of notebook technology.

• List Price: *Librex T386SX, with 4MB RAM, 40MB hard disk, $2,499; 80MB hard disk, $999; 120MB hard disk, $1,599; fax/modem card, $499. Librex Computer Systems Inc., 1140 Ringwood Ct., San Jose, CA 95131; 800-248-4880, 408-441-8500.*

Circle 422 on reader service card

Samsung NoteMaster 386SXL/25

BY MITT JONES

Like the Librex, the new $2,299 Samsung NoteMaster 386SXL/25 has a removable hard disk. While some buyers will balk at the relatively short battery life of this capable, 5.8-pound notebook, the well-designed hard disk provides welcome flexibility.

Based on the 25-MHz Am386SXL processor, the NoteMaster measures a trim 1.8 by 11 by 8.5 inches, comes with 2MB of RAM, employs a 10-inch LCD VGA display capable of 64 shades of gray, and provides a 25-pin parallel port, a 9-pin serial port, a 15-pin external VGA port, and a mini-PS/2-style mouse/keyboard connector.

A compartment along the left-hand side accepts up to two proprietary expansion modules. Our evaluation unit added a 9,600-bps fax/data modem ($399) and 2MB of RAM ($349). It accepts a maximum of 8MB of RAM.

Our test unit turned in a disappointing battery rundown time of 1 hour 38 minutes, but the nickle cadmium battery weighs only 0.7 pounds, which helps explain the low battery life. The notebook performed about average on our processor, memory, and disk tests, but it dropped below average on our video and Graphics Winmark tests.

If you are able to overlook its short battery life, the Samsung NoteMaster 386SXL/25 should prove a bargain with just the right mix: low weight, low cost, and solid performance.

• List Price: NoteMaster 386SXL/25, *with 2MB RAM, 60MB hard disk, DOS 5.0, utilities, $2,299; 2,400-bps data modem, $249. Samsung Electronics America, Information Systems Division, 105 Challenger Rd., Ridgefield Park, NJ 07660; 201-229-4000; fax, 201-229-4047.*

Circle 424 on reader service card

ROAD WARRIORS: *The Librex T386SX, Samsung NoteMaster 386SXL/25, and ZDS Z-Note 325L.*

ZDS Z-Note 325L

BY DON WILLMOTT

Zenith Data Systems has filled the $3,599 386SL/25-based Z-Note 325L Model 60 with some novel ideas and wrapped them up in an attractive new case that foreshadows the future look of all ZDS systems, both desktops and portables.

The 6-pound Z-Note (8 pounds with its too-large AC adapter) comes with 2MB of RAM, a 60MB hard disk, and a backlit LCD panel capable of 64 shades of gray. Chief among its innovations is its LAN-ready status. Client shells for LAN Manager, NetWare, and VINES networks are preinstalled, and a built-in thick Ethernet adapter and Ethernet chip set on the motherboard send data at speeds up to four times that of external LAN adapters. Thin Ethernet and twisted-pair 10BaseT adapters retail for $129 each.

Another innovative option is the $149 Readydesk Port Replicator, a 2-inch-deep accessory that attaches to a port. The Replicator's parallel, serial, VGA, mouse, and AC-power connections match the Z-Note's own ports. The device lets you make a quick getaway (or homecoming) if you're using your Z-Note as a desktop PC as well as a portable.

Power-saving features include the SL chip itself and a clever rest/resume feature that lets you close the machine and pick up exactly where you left off—even days later.

The Z-Note was the best performer on our battery rundown test, lasting almost 4 hours. On other tests, it performed like other 386SL systems, coming in slightly above average on our Graphics Winmark test and below average on tests of video speed.

An upcoming active-matrix color model should prove enticing (and expensive), but for now, the Z-Note is an admirable system, especially for users who want to plug right into a LAN.

• List Price: *Zenith Data Systems Z-Note 325L Model 60, with 2MB RAM, 60MB hard disk, $3,599; with 85MB hard disk, Logitech TrackMan, $4,299; with 120MB hard disk, $4,899; 2,400-bps modem, $349. Zenith Data Systems, 2150 E. Lake Cook Rd., 553-0331.*

Circle 430 on reader service card

CorelDRAW

CONTINUED FROM PAGE 39

ments include the ability to edit an image in preview mode and to type text directly on-screen. In addition, the new layer manager serves a dual purpose. You can organize complex drawings by segregating elements into discrete layers, and a special grid layer lets you use any kind of object as a guideline.

Perhaps the most dramatic addition to Corel 3.0 is a new modeless dialog box called a Roll Up window. Roll Ups give you push-button control over Corel's impressive collection of formatting options and special effects (such as 3-D extrusions, text along a path, and blends). For example, the Extrude Roll Up window lets you set the position and strength of a light source by clicking on an icon of the sun.

PAGE LAYOUTS

Corel 2.0 made it possible to create page layouts by adding paragraph text controls and automatic columns. Version 3.0 builds upon these DTP-like features by adding a spell-checker, a thesaurus, and hyphenation functions. Unfortunately, the program still can't automatically wrap text around other objects.

Although the program will work with Windows 3.0, using Windows 3.1 will simplify access to the TrueType and Adobe Type 1 fonts that Corel now supports directly. The floppy disk installation of Corel contains over 150 TrueType fonts.

The old WFNBoss utility that let users translate Type 1 fonts into Corel's proprietary font format is history. Creating Type 1 (and even TrueType) fonts is now a simple matter of using an export filter.

The Corel Graphics Toolkit takes full advantage of OLE (object linking and embedding). You can insert Corel drawings directly into applications like Word for Windows or insert Excel spreadsheets directly into a CorelDRAW file.

The CorelShow screen-show utility can handle only the most basic presentation tasks. You can set a page size, choose a single background for the entire presentation, generate printouts, and assign transition effects. Amenities are few, but do include a slide sorter and the capability to play back Autodesk animations.

Where other programs—notably Adobe Illustrator (reviewed on page 54) and Arts and Letters Editor—include a charting tool, Corel delivers an entire charting program. CorelChart is a powerful program that can graph up to 16 million data points. In addition to standard business graphs (like pie, bar, and line charts), CorelChart can produce histograms, dual *y*-axes, standard deviations, regression analysis, and true 3-D graphs.

FACT FILE

CorelDRAW, Version 3.0

Corel Corp., 1600 Carling Ave., Ottawa, Ontario, K1Z 8R7 Canada; 800-836-3729, 613-728-8200; fax, 613-761-9176

List Price: With floppy disks and CD-ROM, $595; CD-ROM alone, $549; upgrade, $149.

Requires: 4MB RAM (8MB recommended), 10MB hard disk space (23MB for full installation), Microsoft Windows 3.0 or later.

In Short: With a vector drawing program, a charting program, a bitmap image editor, and a screen-show utility, Corel 3.0 may be the only graphics tool a business user needs. Add to that a CD with over 12,000 clip-art symbols and 256 fonts (TrueType and Adobe Type 1 formats) and you have an incredible value.

421 ON READER SERVICE CARD

Although CorelChart does contain several drawing tools similar to CorelDRAW, it doesn't duplicate its sibling's straightforward interface. For example, you must use the Data Manager and formatting options to create your charts. On the plus side, the spreadsheet nature of the Data Manager allows you to import dBASE, Excel, and Lotus 1-2-3 files directly. But limited formatting options are a real minus.

MORE TOOLS

Corel Photo-Paint is a full-featured image-editor that handles 24-bit digitized color images. Both the strength and weakness of Corel Photo-Paint are apparent when you realize that this product is basically ZSoft Photo-Finish with a new name.

Filters let you improve an image by adjusting its brightness level and contrast or by editing the gray/color map. Special effects are easy to use.

Our testing of the Corel Graphics Toolkit revealed several shortcomings. Understandably, the program's new ability to recalculate special effects on the fly slows down performance. And you'll need the new Refresh command to clear up the distracting screen artifacts.

More seriously, CorelChart files did not display or print properly when they were embedded as OLE objects in CorelDRAW documents. Power users will also find that Corel can still generate complex curves that bomb out a PostScript interpreter. The new Auto Increase feature will boost the curve flatness setting at print time, but this can degrade the quality of the printout.

There is no denying that CorelDRAW gives you incredible bang for the buck. While professional artists may opt for specialized drawing programs with an emphasis on high-quality output, business users who need a wide variety of graphics functions shouldn't pass up this package. It is an amazing bargain. □

▪ A Special CD-ROM

If you want to buy a CD-ROM drive, check out the latest version of CorelDRAW. Each copy ships with a bonus compact disk.

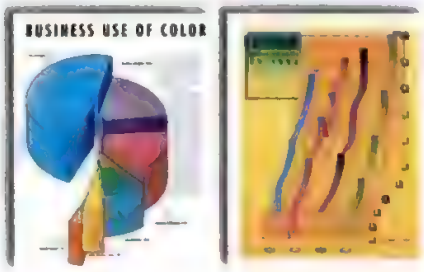
That single silver platter contains all of the program code, plus 12,000 clip-art images and symbols, 256 fonts supplied in both the TrueType and Adobe Type 1 formats, 55 CorelChart templates, 130 Autodesk animation files, and over 130 backgrounds for use with the CorelShow utility. By comparison, the floppy disk installation of CorelDRAW includes only 4,000 clip-art images and a little more than 150 TrueType fonts.

The incredible clip-art collection is like an alphabet of images, including dragonflies and decorative frames, helicopters and heraldic crests, tropical fish and a female doctor.

Handling this overwhelming clip-art collection is made manageable by Corel's file-management tools, for image previewing, sorting, and searching.—*LS*

HP's PaintJet XL300. Now, brilliance doesn't require genius to install.

At last. A 300 dpi color printer that's as easy to add to your system as a LaserJet.



Vivid color has never been so simple. The new PaintJet XL300 inkjet printer gives you laser-quality color graphics, text, and the compatibility of HP LaserJet printers. All for the remarkably low price of just $3,495.*

The PaintJet XL300 has LaserJet compatibility built right in. The same typefaces. The same page formatting. It also has PC/Macintosh auto-switching, so users in a mixed environment can share. And, just like a LaserJet, the PaintJet XL300 becomes network-ready with optional HP JetDirect interface cards.

Get laser-quality printing on a choice of media that includes plain paper and transparencies. Or add Adobe® PostScript® for access to even more graphics applications.

See how easily the PaintJet XL300 can bring color to your system. Call **1-800-752-0900, Ext. 3158** for a free print sample and the name of the authorized HP dealer nearest you.†

HEWLETT PACKARD

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CIRCLE 116 ON READER SERVICE CARD

Windows Utilities

PowerPoint 3.0 Adds Outliner and Drawing Tools for Serious Presenters

BY ROBIN RASKIN

Microsoft's $495 PowerPoint, Version 3.0, a major revamp of one of the original Windows presentation packages, packs new power with a vengeance. Many weak spots have been strengthened, and many of its new features—a WYSIWYG drag-and-drop outliner, a modeless text tool with no special text editor required, TrueType font embedding, a shape tool, and editable clip art—are downright fun to work with. Its OLE implementation works flawlessly, at least with other Microsoft products—a step in the right direction.

Unlike Lotus's Freelance Graphics for Windows, which was awarded an Editors' Choice in our last presentation roundup (March 17, 1992), PowerPoint's deliberate avoidance of what are referred to as "multiple masters" (the same background applied to a number of different types of graphical layouts) increases flexibility, but gives you less guidance as to the placement of graphic elements on the slide. (The lack of multiple masters does make it much easier to switch templates or design your own, however.) Its lack of a clip-art preview feature or table editor is a time-consuming drawback.

Still, PowerPoint moves effortlessly between views in a presentation: single frame, outline, speaker's notes, and slide sorter. Each of these views can have its own "single" master, or background, applied throughout. And PowerPoint ships with 160 templates (masters with color schemes attached), divided into categories based on device (35-mm, black-and-white overhead, and so on).

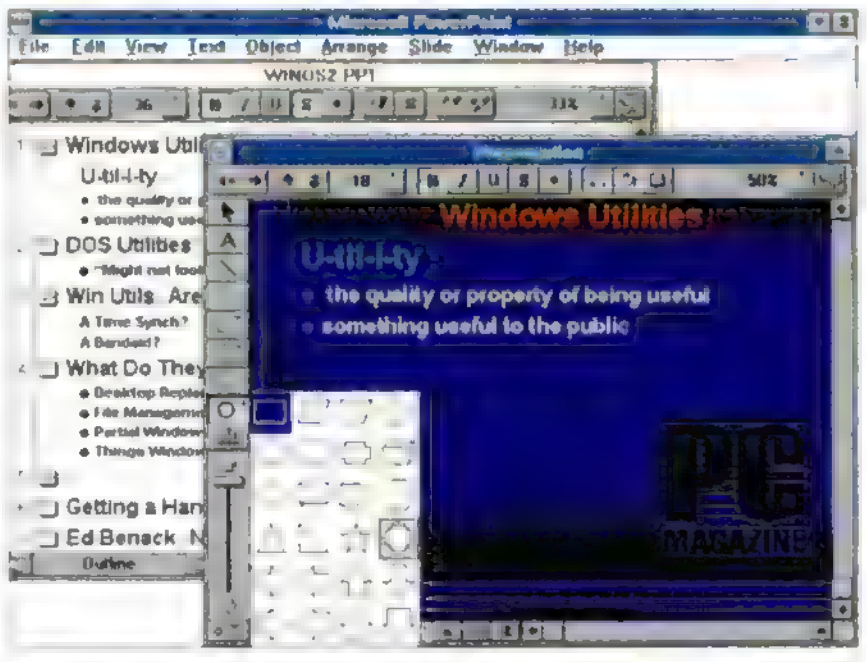
STRONG TOOLSET

The program's toolset is its strong suit. For example, you can convert any shape drawn with the free-form shape tool to its component Bezier curves and edit the shape by yanking on the nodes. The modeless text tool lets you edit text anytime, anywhere, without being forced to enter a text-editing mode, and you can always be in WYSIWYG mode, even in the outliner.

A new tool that offers a menu of commonly used shapes helps you make drawings and diagrams quickly. As you add shapes to your slides, you can enter automatically centered text into the shape.

EDITABLE CLIP ART

Clip art is fully editable and is hierarchically grouped. So, for example, you can select just one person from a "group meeting" piece of clip art, or you can even zoom in to use only the head of one of the people in the picture. It's a great way to get mileage from the clip-art library.



DRAG AND DROP: *PowerPoint 3.0 includes a WYSIWYG outliner to help build presentations.*

The powerful Pick Up and Apply Style toolbar buttons let you copy all the attributes of a selected object (or even an entire slide) and apply them elsewhere in the presentation, providing an open-ended way to do everything from creating a stamp tool to duplicating a color scheme.

The graph component has been upgraded to include Microsoft graph's 3.0b features (it will read Excel 4.0 graphs and files) and includes attractive 3-D charts with rotations, combinations, and overlay charts. Sizing and placing graphs is easier than in other packages.

Likewise, building an on-screen presentation has never been easier. The screen show has the obligatory transition effects, but it also incorporates a no-brainer way of creating builds and reveal slides. PowerPoint also debuts a "Madden" tool, a way of doodling on your screen during a presentation that gets its name from John Madden, television's electronic chalkboard sportscaster.

There is no way to make a DOS runtime presentation (as you can with the Freelance), but the PowerPoint Viewer is one of the program's most intriguing features. PowerPoint is the first product that lets you embed fonts in your presentation. By distributing the Viewer module, you can transmit your presentation to a colleague, who in turn can view it under Windows with all fonts intact—even if those fonts are not normally available on his machine.

Other nice touches include a healthy set of graphics imports, a series of time-saving templates for nasty jobs like org charts, a decent spell-checker, the ability to embed sound in a frame (albeit not linked to a particular object), and embossed effects.

PowerPoint has plenty of tools and many clever touches. The power is definitely there, and with a little more attention to design guidelines, the ease of use for quick presentation building will be there, too. □

FACT FILE

PowerPoint, Version 3.0

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400

List Price: $495.

Requires: 2MB RAM (4MB recommended), 2MB hard disk space; Microsoft Windows 3.1 or later.

In Short: PowerPoint takes the lead in features: embedded TrueType fonts, editable clip art, a clean OLE implementation, a Word for Windows–like outliner, a nifty shape tool, and the easiest build and reveal slides in the business. But some subtle usability issues make it tough to design quick-and-dirty presentations.

426 ON READER SERVICE CARD

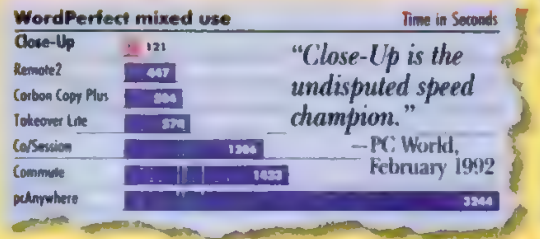
Now Supports Both Windows & DOS

Close-Up Wins Remote Honors

PC WORLD

Close-Up is fast, easy to use, and reliable. What else do you need in a remote package?

Close-Up Dual Pack 4.0 earns its Best Buy by virtue of lightning speed, an easy interface, reliable error handling, and a complete set of tools for controlling one computer from another and collaborating with a partner. It's also the only package that can run Windows reliably from afar—even in extended mode. Runner-up **Remote2** isn't quite as fast, and its toolbox is smaller, but it is perfectly dependable with graphics.



"Close-Up is the undisputed speed champion."
—PC World, February 1992

Excellent ★★★★
Good ★★★
Fair ★★
Poor ★

Carbon Copy Plus 6.0	671	☆☆½	☆☆½	☆☆	☆☆☆½	☆☆½	☆☆	☆☆☆½	★★½
Control Point Commute 1.1	673	☆½	☆½	☆☆	☆☆	☆☆	½	☆☆☆☆	★★
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CO/Session 6.0	674	☆☆☆½	☆☆½	☆½	☆☆	☆☆☆½	☆½	☆☆☆½	★★½
pcAnywhere 4.03c	675	½	☆☆	☆½	☆☆☆☆	☆☆	☆	☆☆☆½	★½
Remote2 2.1	676	☆☆☆	☆☆☆☆	☆☆½	☆☆½	☆☆☆½	☆☆½	☆☆☆½	★★★
Takeover Lite 2.0	677	☆½	☆½	☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆½	★★

Overall value is calculated by multiplying each category rating by the category's weight percentage, summing the results, and rounding to the nearest half number.

Remote Performance: Why Close-Up is Best

- *Supports both Windows and DOS with the same program.*
- *Fastest VGA, EGA and CGA graphics.*
- *Fastest file transfers and remote screens.*
- *Runs Windows in all 3 modes. No restrictions.*
- *Runs multiple Windows and DOS applications simultaneously, full-screen or windowed.*
- *Remote mouse and keyboard control.*
- *Self-installing, fully-automated for fast, easy operation.*

Call for FREE Working Model

Actual test results reprinted from PC World's Review of Remote Communications Software, February 1992.

"Close-Up...The Best Program You Can Buy for Remote Control"

—Reprinted from PC Magazine, January 14, 1992

The Ultimate Remote Program

"Norton-Lambert's Close-Up is the fastest, easiest, and the most reliable program we looked at..." —PC World, February 1992

The results are in and the experts agree. New Close-Up 4.0 has proven time and again to be the most advanced remote control system available.

Close-Up lets you view & control PCs miles away *by modem*. Now with full support for Windows, DOS, graphics and mice at record-breaking speeds, Close-Up is the fastest, easiest way to handle all your remote communications needs.

What You Can Do:

- ✔ Take control of PCs at any location.
- ✔ Work remotely on the road via laptop.
- ✔ Control your office PC from home.
- ✔ Access your company's branch offices.
- ✔ Train your associates on any application.
- ✔ Help customers miles away, remotely.
- ✔ Transfer text, data, any file between PCs.
- ✔ Remotely install and run Windows.
- ✔ Automate remote operations at night.
- ✔ Access networks all over the world.

PC MAGAZINE BEST OF 1991 — January 1992
PC WORLD BEST BUY — February 1992
LAN TIMES RECOMMENDED NETWORKING — November 1991
PC MAGAZINE EDITORS' CHOICE — February 1992

Winner of the Top Awards

"Close-Up has been highly polished and it's flexibility and capability clearly make it the best program you can buy for remote control."
—PC Magazine "Best of 1991," January 14, 1992

"If you're serious about going remote, check out Close-Up. The program's handling of Windows is simply dazzling."
—PC World "Best Buy," February 1992

"Close-Up is one of the fastest products we've seen. It had the fastest file transfer times and the shortest times redrawing the screens."
—LAN Times, November 18, 1991

"You will not find a better all-around remote-control program."
—PC Magazine "Editors' Choice," February 25, 1992

Control both Windows and DOS with just one program

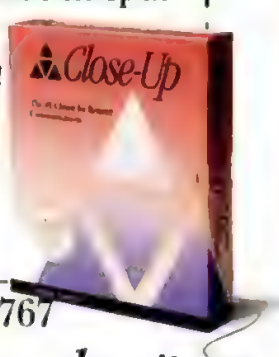
Now with double the remote power, Close-Up gives you full support of *both* Windows and DOS. That's like getting two remote programs for the price of one!

Spectacular Savings!

Now you can receive the Close-Up 4.0 Dual Pack including both sides for only $199—you save $240!

Upgrade Now!

Upgrade your current remote program to new Close-Up 4.0. Call for special pricing.



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CIRCLE 028 ON READER SERVICE CARD

PIMs

Instant Recall 2.0: Info from Any Angle

BY JONATHAN MATZKIN

No personal information manager can be all things to all people, but Version 2.0 of Chronologic's $129 Instant Recall could very well be the first PIM for the masses.

The philosophy behind Instant Recall—that users know best how they want to view their personal data and should be given the chance to slice and dice it any way they want—results in a simple program that many people can use productively but in strikingly different ways.

CAN YOU MAKE IT? *Instant Recall finds blocks of free time in your schedule.*

This significant upgrade preserves that philosophy, extends many of the program's capabilities, and adds new flexibility. A separate version for NetBIOS-compatible networks, called Instant Recall Office, introduces IR to workgroups. There are still some imperfections and a few missing or incomplete features, but Version 2.0 solidifies Instant Recall's position as the PIM that best balances simplicity and functionality.

IR now supports databases as large as 65,000 entries, or 4 billion characters of text. Background indexing allows rapid searching of even the largest databases. The search algorithm now assumes a Boolean AND between multiple words of a search string, so the search finds both entries that have the explicit phrase and the component words of the phrase.

Users who share databases or use multiple machines will appreciate the new reconciliation features. Duplicate entries are automatically discarded, and incoming schedule items are checked for conflicts with the receiving database.

CUSTOM START-UP VIEWS

Another change allows users to choose any of IR's data views as a start-up default. Many users rely heavily on a single view within the program, but not necessarily the default Daily view that summarizes information for the current date. Task-driven users, for example, may rely almost exclusively on the Schedule or Open Time views; Version 2.0 lets these users choose either of those (or any of the other views, for that matter) as the initial screen.

Previous versions allowed auto-dialing of phone numbers only from the People view, but Version 2.0's pop-up dialer now allows dialing of any number, in any view, just about anywhere in the program. In TSR mode, the pop-up dialer can even detect and dial numbers in the screens of external applications.

Reporting has been substantially beefed-up in Version 2.0. You can generate annotated calendars, address books, task or project lists, pages for loose-leaf organizers, mailing labels, and a number of other report formats. A custom report option allows adjustment of headers, footers, margins, font sizes, and field selection, among other characteristics.

SHARPER VIEWS

Beyond the global changes that affect overall program operation and performance, there have been evolutionary enhancements in the individual views. The Notes view has enhanced word processing capabilities, including the ability to set tabs, margins, and indents. The People view now allows you to sort entries alphabetically by name, alphabetically by company name, or by ZIP code. The scheduler automatically finds open time—a boon for harried managers with more meetings than hours in the day. The scheduler's alarm function now has a snooze function.

Support for palmtop file transfer acknowledges the natural synergy between PIMs and data containers like Hewlett-Packard's 95LX or the Sharp Wizard. Unfortunately, support for these diminutive machines is incomplete at best. For all three, you must transfer the appropriate IR files using the primitive software supplied by the palmtop manufacturers. Far better would be a component within IR itself, or at least support for Intellilink. Beyond the limitations of the transfer software supplied by the palmtop manufacturers, not all IR entry types can be transferred to the laptops, and entries are restricted in length.

INSTANT RECALL OFFICE

Instant Recall Office not only brings this outstanding PIM to networks, but also adds e-mail and group scheduling. The standalone version can read e-mail messages in a special network-emulation mode, allowing free exchange of information when passing data between 2.0 and Office. It also automatically reads the Novell Bindery so that you can easily assign users to IR when setting it up on the LAN.

Die-hard users of IR 1.2 may be surprised to find some keystrokes remapped, and the new search algorithm may take getting used to. But the wealth of innovative changes combined with the preservation of IR's basic look and feel should leave longtime users very satisfied. If you haven't yet tried IR, now is a great time to take the plunge. □

FACT FILE

Instant Recall, Version 2.0

Chronologic Corp., 5151 N. Oracle, #210, Tucson, AZ 85704; 800-848-4970, 602-293-3100; fax, 602-293-0709

List Price: $129; upgrade, $39.95
Requires: 512K RAM, 1MB hard disk space, DOS 3.1 or later
List Price: Instant Recall Office, Version 1.0, for 2 to 100 users, $249-$4,995
Requires: Novell NetWare 2.15 or later or other NetBIOS-compatible networks
In Short: Version 2.0 of this simple, flexible PIM includes numerous enhancements to data views and reporting, while the new Instant Recall Office offers simple but complete group-scheduling tools

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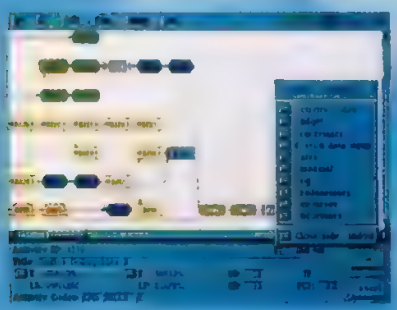

Work with activity codes, budgets, predecessors and successors, custom data items and more—all within Primavera's graphic user interface.

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Primavera does custom data better. For specialized information, Primavera now lets you add custom data items to the project database, and use them to sort, select and sequence data in reports.

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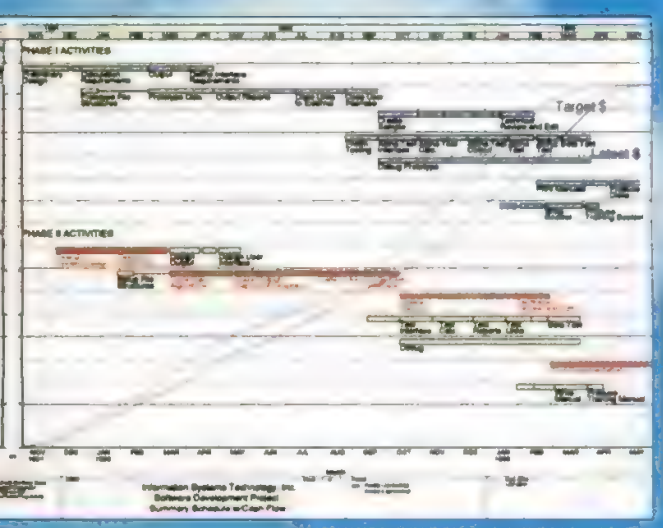
How about a face-to-face meeting? Call 1-800-423-0245 for more information or a **free video demo** of the software you've always dreamed of.



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CIRCLE 148 ON READER SERVICE CARD

Printers

HP PaintJet XL300: The Affordable Way To Get 11- by 17-Inch Color Output

BY ALFRED POOR

Windows applications have brought more and more colorful images to our screens, but getting all that color output to paper affordably hasn't been easy.

Hewlett-Packard Co., which took a stab at affordable color output with the $1,095 DeskJet 500C (First Looks, January 28, 1992), is back with a new printer that fills the gap between the DeskJet and more expensive thermal wax transfer printers that cost between $5,000 and $10,000. At $3,495, the new PaintJet XL300 offers high-quality 300-dot-per-inch color output with lots of extras.

The PaintJet is much larger than its DeskJet cousin. Measuring 10 by 30 by 20 inches (HWD) and weighing in at nearly 60 pounds, this is not something you perch on the corner of your desk. On the other hand, it has many more capabilities than the smaller DeskJets, including 11- by 17-inch printing capability.

Open the hood of the DeskJet and you'll see an all-black ink cartridge and a three-color cartridge; you use one or the other. The PaintJet XL300 uses four separate cartridges: black, cyan, yellow, and magenta. Therefore, when one color runs out, you do not have to replace the others as well. The cartridges cost $24.95 apiece (except the black, which costs $21.95), and HP rates them for 320 pages at 15 percent coverage per page. HP estimates this to be 18 cents per page plus the cost of the paper, which is way below the price of thermal transfer printing.

BIG COLOR: *The PaintJet XL300 has a built-in fan and heat lamp to help dry the ink as soon as it hits the paper.*

In terms of output quality, the PaintJet XL300 holds its own against more expensive thermal transfer designs. There is no evidence of banding in the output on plain paper, and you need a magnifying glass to detect the difference between text samples printed on this printer and a LaserJet.

Using special coated paper or transparencies available from HP, the colors are as vivid and bright as thermal transfer, but with more even coverage. The only quality problems we saw were some moiré patterns that occurred while printing blocks of PCL shading patterns.

One reason that the PaintJet XL300 manages such top-quality output is that the printer includes a heat lamp and fan that help dry the ink as soon as it is printed onto the paper.

The printer is easy to set up and operate. It comes with both a parallel and an AppleTalk/RS-422 interface, and both can be active, which makes it simple to share the printer between two computers. The only surprise in setting up the printer is that it can take up to 5 minutes to initialize from the moment you turn on the power.

The printer comes with drivers for Windows (3.0 and 3.1) and for the Macintosh, so it's ready for cross-platform installations. For PC users, the PaintJet XL300 comes with one other handy feature: PCL 5 compatibility. The only small glitch in the PaintJet XL300's compatibility is that it doesn't support Mode 5 bitmapped image compression, which is supported by some LaserJet IIIs.

On the other hand, the PaintJet XL300 offers some surprising compatibility features with the LaserJet line. It accepts the same fonts (and cartridges) as the LaserJets. It can also use the LaserJet IIISi JetDirect expansion cards to connect to Token-Ring or Ethernet networks.

The base unit comes with 2MB of RAM, which can be expanded up to 18MB using SIMMs and a memory expansion card. HP plans to release an Adobe PostScript Level 2 version of this printer this summer, with 6MB of memory for $4,995. If you buy the XL300 now, you will be able to upgrade it to the PostScript version with a kit slated to list for $1,995.

If you are using Windows, however, you may not need the PostScript upgrade. The PCL version we tested was comparable in speed to the $5,000 to $10,000 thermal transfer page printers, averaging just over 2 minutes per page on our graphics speed test (which does not take advantage of the PCL 5 compression modes).

For text, the PaintJet XL300 was a bit slow at only 0.6 pages per minute, but you are not likely to use this much printer just for text. And the fact that it can print on 11- by 17-inch pages gives it a competitive edge over most other color page printers on the market.

If you need top-quality color output performance for Windows at an affordable price, put the PaintJet XL300 at the top of your list. □

FACT FILE

PaintJet XL300

Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051; 800-752-0900; fax, 208-344-4809

List Price: $3,495
Requires: Parallel port
In Short: The PaintJet XL300 offers 300-dpi color printing with excellent quality on pages up to 11 by 17 inches at an affordable price

401 ON READER SERVICE CARD

Can You Spot The Winner?

rway 2000
The Winners Circle

Gateway 2000 employees were photographed for the summer fun ad at Atokad Park in South Sioux City, Nebraska.

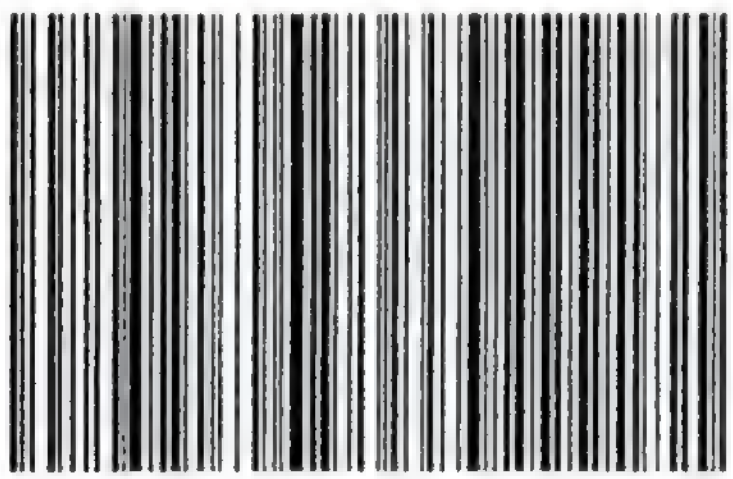
Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

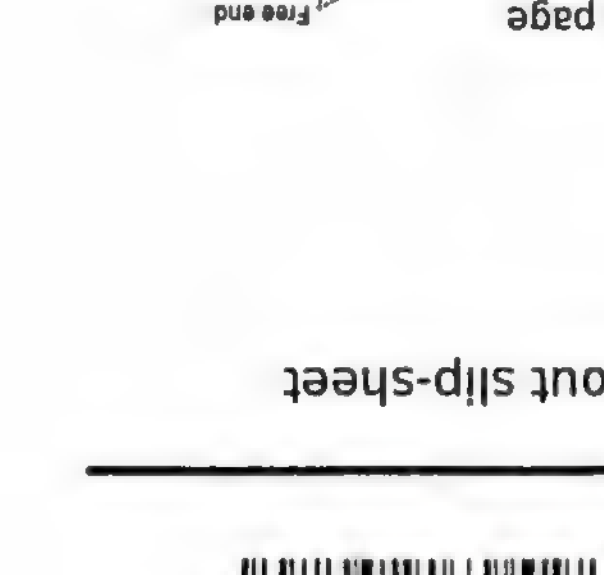
Folded edge of the page



GbsSlipSheet-001

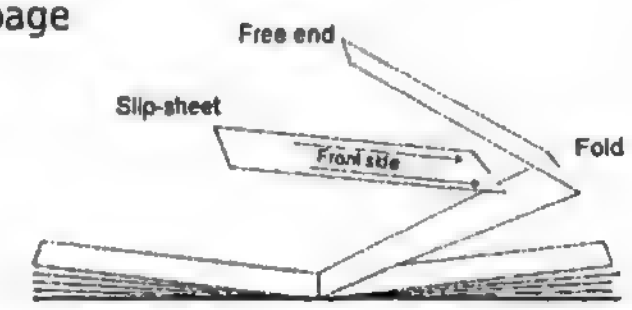
Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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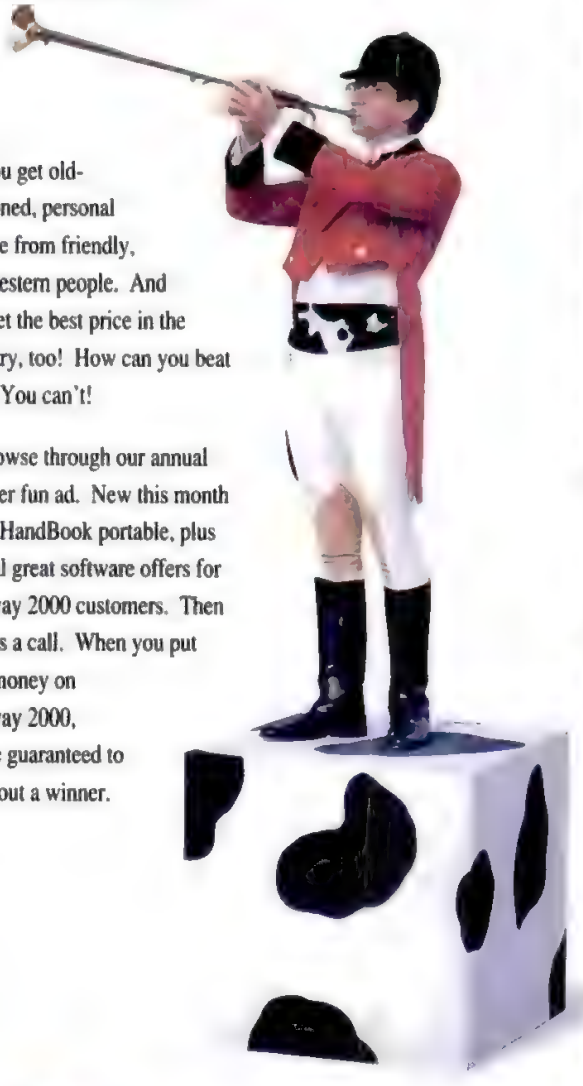

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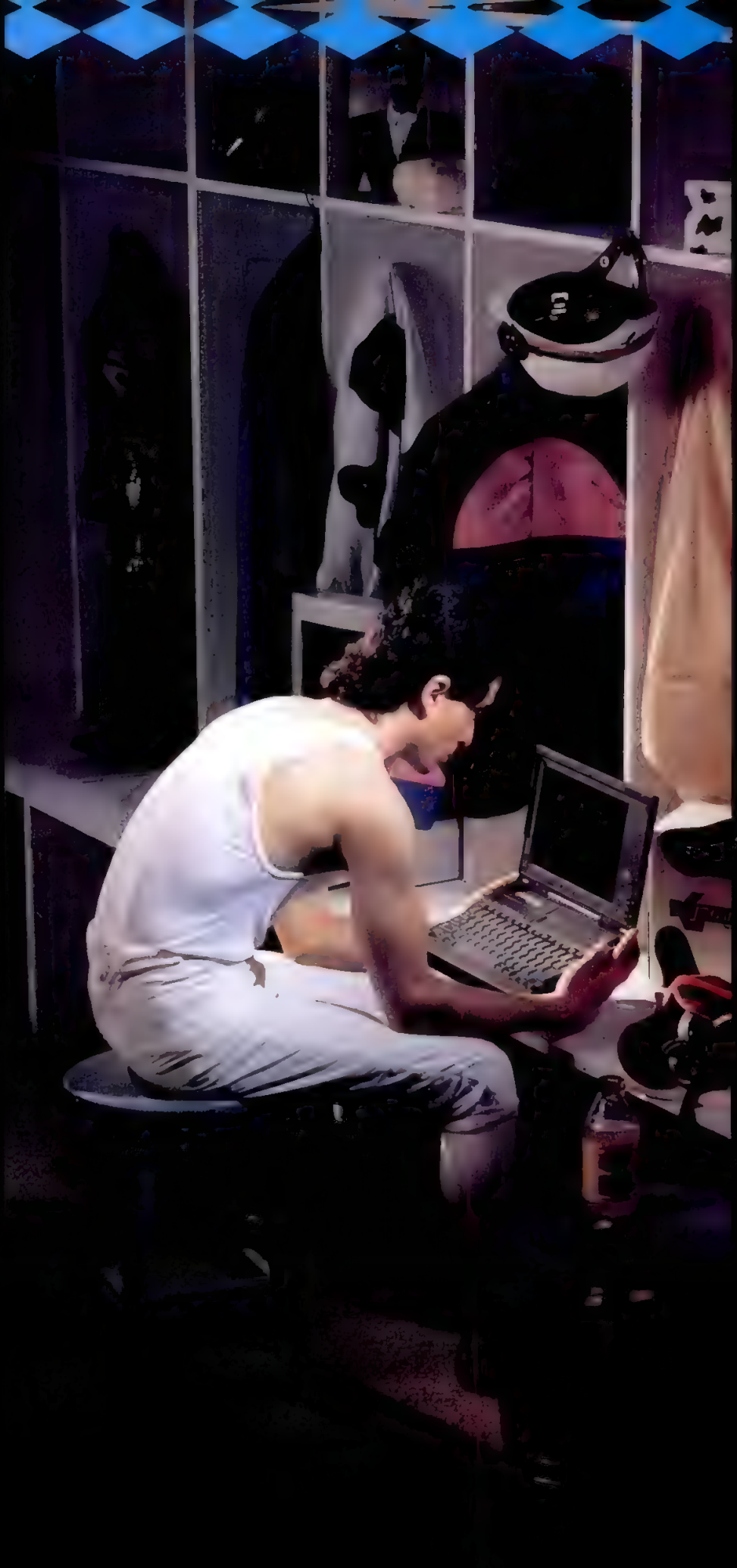
Browse through our annual summer fun ad. New this month is our HandBook portable, plus several great software offers for Gateway 2000 customers. Then give us a call. When you put your money on Gateway 2000, you're guaranteed to come out a winner.

GATEWAY2000

"You've got a friend in the business."



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Our small, lightweight Nomad notebook computers let you take desktop computer performance anywhere you go. Nomad models come with VGA graphics, a FieldMouse™ (portable pointing device), built-in floppy drive, and an 80 or 120MB hard drive, depending on the model. A patented power-management system gives you hard-to-beat battery life benchmarks — over six hours of operation from a single battery on the 25MHz 486DX system!

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Since the Nomad 425DXL has all the power of a 486DX desktop system, it's the ideal portable/desktop combination system! Save with this combo package!

Combo Highlights: Nomad 425DXL ■ 15" CrystalScan 1572FS color monitor ■ programmable 124-key AnyKey™ keyboard

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If you like to travel light, you can't go wrong with the HandBook. It weighs only 2.75 pounds and measures roughly 6 x 9 inches — smaller than this magazine! Yet it has 286-class performance and real PC features including a bright, backlit screen, a bonafide 40MB hard drive and a comfortable keyboard (no chiclet keys). Downloading information from your HandBook to your office computer is easy with the serial cable and file transfer software provided.

HandBook ■ $1295

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33MHz 486DX ■ $2395

We recently increased performance and lowered the price of our best-selling, award-winning 486DX/33 by adding an ATI Graphics Ultra video card with a graphics coprocessor. At $2,395, the price/performance ratio on this machine is hard to beat. Plus, it's an upgradeable PC. You'll be able to switch to 66MHz later this year. ***System Highlights:*** 64K cache RAM ■ 4MB RAM ■ 200MB Western Digital IDE hard drive ■ ATI Graphics Ultra ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ desktop model is standard

50MHz 486DX2 ■ $2695

Gateway 2000's new 486DX2/50 systems, ISA and EISA, incorporate Intel's speed doubler technology. The internal core of the DX2 processor executes at 50MHz while communicating with the external memory bus at 25MHz. Our benchmarks show a 35% increase in performance over a 33MHz 486DX PC.

The high-performance ATI card is standard on the 486DX2/50 as well, plus this system incorporates our new RIDE technology for faster disk operations. RIDE stands for Rapid Integrated Drive Electronics. RIDE technology takes advantage of our new system BIOS that allows the drive to transfer bigger data blocks at one time. Our Coretest benchmarks show large block disk-to-memory operations are over 30% faster with RIDE. For example, you'll notice the increased performance whenever you type WIN at the system prompt, or when you double-click on an icon in Windows. It's much faster. Our product marketing director claims the 486DX2/50 with the ATI video card and RIDE is the fastest personal computer he's ever used!

System Highlights: 64K cache RAM ■ 8MB RAM ■ 200MB Western Digital IDE hard drive with RIDE BIOS ■ ATI Graphics Ultra ■ 14" CrystalScan 1024NI VGA color monitor, up to 1024 x 768 non-interlaced resolution ■ desktop model is standard

EISA SYSTEMS

Our product line includes two EISA systems — a 33MHz 486DX and a 50MHz 486DX2. Both EISA systems now come standard in a floor-standing tower model, and include large, fast SCSI drives and EISA SCSI controllers. RAM cache is expandable to 256K. The 486DX/33 EISA will be upgradeable to 66MHz later this year.

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486DX/33 EISA ■ $3795 (Upgradeable to 66MHz later this year.)
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Gateway 2000 systems come fully configured with all the performance features you want, including two floppy drives, a programmable 124-key AnyKey keyboard, a Microsoft® mouse, MS DOS® 5.0, Windows™ 3.1 and your choice of one application software option. See the back pages of this ad for complete configurations and information about software options, upgrades and peripherals.

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The Gateway Team Is Behind You All The Way

There's a full team of dedicated service professionals standing behind your Gateway 2000 system. In fact, a recent *PC Magazine* reader survey proved Gateway the clear winner in service and reliability. We whizzed past all the contenders when PC owners were asked, "How likely would you be to buy the same brand system again?" The survey also rated Gateway Number-One in overall system reliability, and we were in the Top Five for tech support and repair service.

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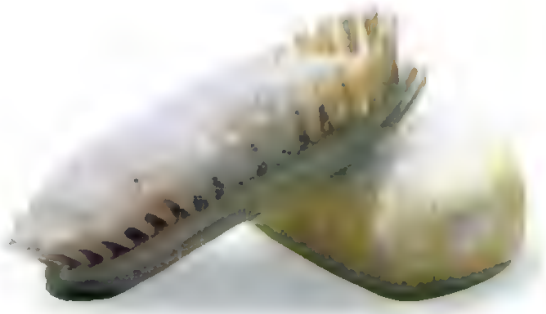
In our company mission statement, one of our stated objectives is to exceed customer expectations in quality, service and value. This objective is a personal challenge to each of us at Gateway. We know how important service is to you, which is why we're constantly striving to provide the best in the business.



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SERVICE

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Choose Your Free Software Option

With the purchase of any Gateway 2000 mini desktop, desktop or tower computer system, you receive your choice of one application software option at no additional cost. We'll install your software on your hard drive, optimally configured for your system and Windows, and provide master diskettes and manuals. You may also purchase a second application software option, pre-installed, at extremely competitive prices.

Installation and setup errors are responsible for over one-third of all software problems. You can eliminate that possible source of problems by purchasing your system from Gateway with software pre-installed, tested, and ready to run the moment your system arrives. Add that advantage to the hard-to-beat prices, and Gateway is the only logical choice for PCs and software!

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■ New version of this powerful spreadsheet, includes online help for *Lotus 1-2-3®* users

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Option #4-*Borland® Paradox 3.5*

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■ Includes everything you need to create programs for Windows: *Microsoft QuickC for Windows,™ Windows Control Development Kit,™ Windows Help Compiler™* and *Windows Programmers' Online Reference.™*

Option #7-*Microsoft Project for Windows™ 3.0*

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NOTE: If you would rather replace an option with *Microsoft Office™*, it is available for $175. This package includes *Word for Windows, Excel* and *PowerPoint.*

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The following applications are only available with the purchase of a system, pre-installed, or to Gateway customers.

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Central Point Backup® 7.2 for Windows ■ $75

The Norton Desktop® 2.0 and Prisma Your Way 2.0 For Windows ■ $95

These offers include the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

Peripherals

The 15-Inch CrystalScan 1572FS

You'll enjoy your new Gateway 2000 computer even more if you choose the new 15-inch CrystalScan color monitor option. The CrystalScan 1572FS has a flat, square, non-glare screen to reduce distortion around the corners and provide edge-to-edge display area.
The CrystalScan 1572FS is an upgrade option only with the purchase of a 386DX or 486 system for an additional $195.

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The Gateway 2000 TelePath is a 14,400 bps mode, V .32bis, with 9,600 bps fax capability. The TelePath comes with WinFax Pro,™ Crosstalk™ for Windows, Qmodem™ and a free 30-day basic services CompuServe® membership — all for only $195!

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■ Data mode: V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42 bis/MNP 5 data compression

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- Introductory Bonus Pack
- Carrying Case

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- 25MHz, 386SXL Processor
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- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 256K
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
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- 79-Key Keyboard
- FieldMouse™ Pointing Device
- MS DOS® 5.0 & Windows™ 3.1

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- 20MHz, Intel® 486SXLP Processor
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- 1.44MB 3.5" Drive
- 80MB IDE Hard Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8", 5.8 Lbs.
- 6-Hr.* NiCad Battery & AC Pack
- 1 Parallel/1 Serial Port
- 79-Key Keyboard
- FieldMouse Pointing Device
- MS DOS 5.0 and Windows 3.1

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NOMAD 425DXL

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- 4MB RAM
- 1.44MB 3.5" Drive
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■ Notebooks

PC Brand and Twinhead Take Different Routes to 486 Notebook Power

BY MITT JONES AND GREG PASTRICK

With notebook users clamoring for more muscle in their portable systems, vendors like PC Brand and Twinhead have hurried to get high-powered systems to market.

PC BRAND GOES WITH CYRIX

In its rush to bring 486 performance to a notebook, PC Brand succeeds mainly in delivering below average 486SX performance at an attractive 386-like price. The company's 6.5-pound, Cyrix 486SLC-based system, the 486/SLC Notebook, costs $1,995 with 2MB RAM, 1K internal processor cache, an 80MB hard disk, and a paper-white VGA display with 32 shades of gray.

Testing showed that the average processor performance of 33-MHz 486DX systems was far faster than the PC Brand notebook, but the PC Brand system was a third faster on processor operations and better on memory tasks than the average 25-MHz 386SL system.

Video and graphics performance was uninspiring, and hard disk performance was below the average for all 25-MHz 386SX and 386SL-based portables. The battery, however, lasted a reassuring 2 hours 30 minutes.

The 486/SLC is supported by many expansion options, including a three-slot chassis and internal data/fax modems ($119 and $249, respectively). Memory can be boosted to 16MB and disk storage to 120MB. When it comes to performance, though, look for better component integration in a system that plays with—not against—the 25-MHz Cyrix 486SLC chip.

TWINHEAD'S 486DX/33 SYSTEM

A 33-MHz 486DX notebook that weighs 5.8-pounds and costs $3,199 with 4MB RAM and an 80MB hard disk? You bet. The Intel-based Twinhead Slimnote 486DX/33 measures a mere 1.7 by 11 by 8.75 inches and accommodates up to 20MB of system memory and a 120MB hard disk. The chief shortcomings of the unit are its lackluster power management and compressed keyboard spacing.

The Slimnote lived up to the promise of its 33-MHz 486DX processor, ranking among the fastest portables ever to hit PC Magazine Labs. The unit's capable, 64-shade VGA subsystem contributed to the blazing speed.

It ran for 2 hours 22 minutes during testing, not bad considering its 486 processor and low weight. Unfortunately, buyers should expect little additional battery life even with power-management features enabled.

It's difficult to recommend a laptop with reduced keyboard spacing and a suspend-mode duration of 3 hours 15 minutes. But for buyers who can live with these drawbacks, the Twinhead Slimnote 486DX/33 is a considerable value. Few machines so small pack so much power at such an alluring price.

486-TO-GO: *The PC Brand 486/SLC Notebook and the Twinhead Slimnote.*

• List Price: *PC Brand 486/SLC Notebook, with 2MB RAM, 1K internal cache, 80MB hard disk, DOS 5.0, Microsoft Windows 3.1, leather case, $1,995. PC Brand Inc., 405 Science Dr., Moorpark, CA 93021; 800-722-7263; 805-378-6174; fax, 800-722-7392.*

Circle 428 on reader service card

• List Price: *Twinhead Slimnote 486DX/33, with 4MB RAM, 80MB hard disk, DOS 5.0, display utilities, $3,199; with 120MB hard disk, $3,599. Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; 800-545-8946; 408-945-0808; fax, 408-945-1080.*

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Benchmark Tests: Notebook PCs

The 486SLC-based PC Brand 486/SLC showed below average hard disk and video performance, but, as expected, outperformed the 386SL average on the processor and memory tests. Twinhead's Slimnote 486DX/33 performed on a par with other 33-MHz 486 systems.

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure the PC's processor, memory, disk, and video subsystem performance. The Graphics Winmark is the geometric mean of 12 Windows-based graphics tests from WINBENCH 2.5, weighted to reflect how frequently various functions are used.

Higher scores represent better performance.	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)	Graphics Winmark (megapixels per second)	Battery Rundown (hours: minutes)
486DX/33 average	351	5,330	121	1,980	2.184	N/A
Slimnote 486DX/33	351	5,343	113	1,981	2.02	2:22
PC Brand 486/SLC (Cyrix 486SLC/25)	188	3,271	56	1,001	1.401	2:30
Cyrix 486SLC/25 average	181	3,000	93	2,691	N/A	N/A
386SL/25 average	127	2,722	86	1,443	1.218	N/A

N/A—Not applicable. PC Magazine Labs has not yet run the test on enough machines of this type to compute a meaningful average score.

Utilities

Norton Desktop for DOS: The Most Graphical DOS File Management Yet

BY EDWARD MENDELSON

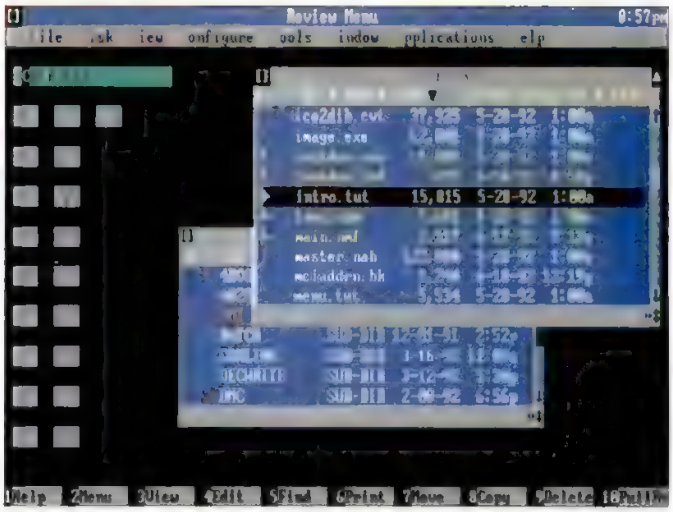
If the name The Norton Desktop for DOS reminds you of the object-oriented drag-and-drop file and program management at the heart of The Norton Desktop for Windows, then you already understand Symantec's $179 package of DOS menus and utilities.

The Norton Desktop for DOS (NDD), Version 1.0, offers the first drag-and-drop interface for the character-based environment of DOS. Its main screen displays drive icons that, when clicked on, open directory tree windows that you can move or resize with the mouse. You can copy or move files by dragging filenames between windows, or compress them in .ZIP format by dragging them to a ZIP file window. To edit a file in Norton's built-in editor (or any editor you specify), you drag its filename to a button bar at the foot of the screen and drop it on a button labeled Edit. To view the contents of a text, graphic, spreadsheet, or database file in its native format, you drop its name on the View button.

NDD, like Windows and PC Tools, lets you associate filename extensions with applications, so when you double-click on NDD.DOC, it opens in Microsoft Word. The file manager needs 512K of RAM and works faster with 1MB of expanded or extended memory, but it fills only 4K of RAM after it launches a program (and less than 1K if you have upper memory blocks available). Don't rush to install it on the 10MB disk in your old XT: The full package takes 8MB of hard disk space, although you can get the essentials in less than half that space.

You can customize much of NDD's screen display, including its top-line menu, its pop-up user menus for launching applications, and even the file manager interface, which can appear in the traditional style of The Norton Commander instead of the new object-oriented style. (A simulated DOS prompt is available when you need it.) The file manager optionally uses check boxes and other quasi-graphic features instead of the familiar characters in the IBM screen font.

The top-line menu gives you access to other utilities in the package, including a calendar and calculator, a graphical screen-saver, a fast file-finder that can remember customized search settings, a file-transfer utility, a database of explanations for error messages, and an MCI Mail interface that seems to have been designed by someone who rarely uses MCI Mail.



WINDOWS-LIKE: *NDD'S file manager lets you drag files from directory windows to drive icons.*

You also get Norton's superb backup program, plus Norton Disk Doctor, a defragmenter, system information, deletion-recovery utilities, and other programs also sold in The Norton Utilities 6.0.

NDD includes Norton's disk cache, which ranks with HyperWare's HyperDisk as the best of its kind. It also includes Norton's slightly less impressive TSR scheduler, virus checker, and warehouser of deleted files. You'll have no trouble with these on standard systems.

INCOMPLETE EXECUTION

But as powerful and original as it is, NDD may remind you of a splendid facade on a building with some empty rooms inside. After you use it to launch an application, you can't see the desktop unless you exit the app. This means you can't jump to the viewer from your word processor to check a graphic or spreadsheet before importing it. If you shell out of your word processor, you reach the DOS prompt, not the desktop.

Compared with the less flashy menu program in WordPerfect Office 3.1, NDD lacks crucial features such as keyboard macros, task switching, and a data-transfer clipboard.

NDD's file manager goes only halfway in its drag-and-drop methods. You launch a file in an application by dropping the filename on the program name. You can't create custom buttons on which you can drop a filename to perform an action. If you select six filenames and drag them to the editor button, only one is loaded—even though the editor can handle six files at once.

Despite these small flaws and limitations, this initial version of NDD seems far more solid and useful than Version 7.1 of rival PC Tools. Symantec's first attempt to create an object-oriented interface for DOS may do more to transform the way you think about DOS than any other program in years. □

FACT FILE

The Norton Desktop for DOS, Version 1.0

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570; fax, 408-255-3334.

List Price: $179.

Requires: 512K RAM, 4MB to 8MB hard disk space, DOS 3.1 or later.

In Short: A drag-and-drop file manager for DOS, brilliantly conceived but incompletely executed, is at the heart of this package of generally superb disk utilities (including Norton's backup program). An amazing bargain, and far simpler to use than rival PC Tools.

426 ON READER SERVICE CARD

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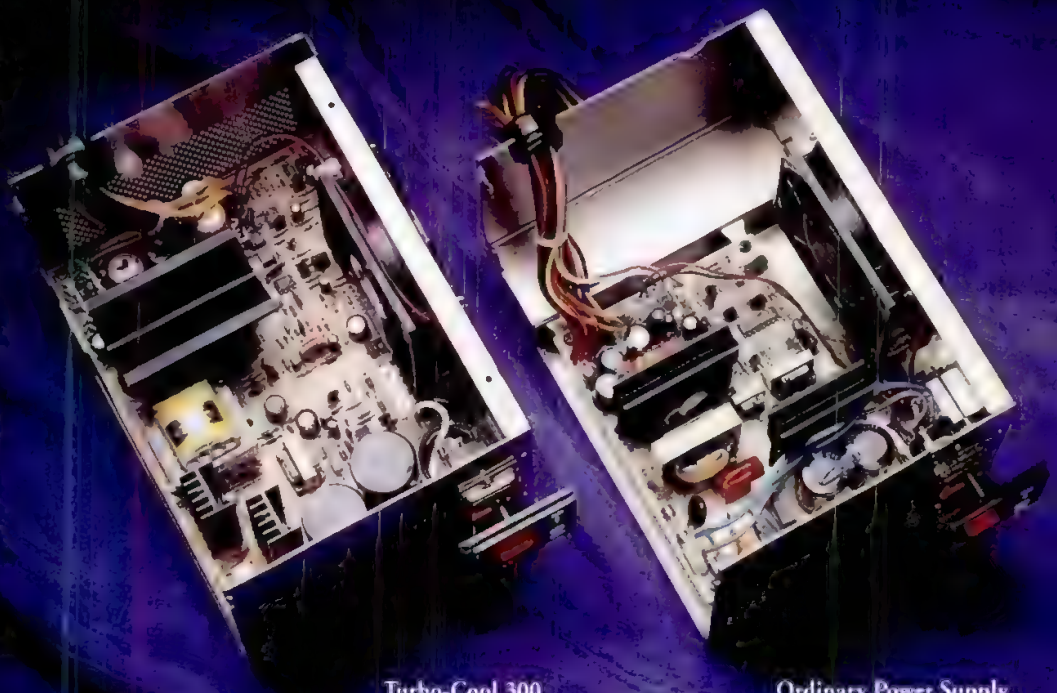

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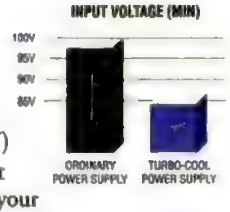

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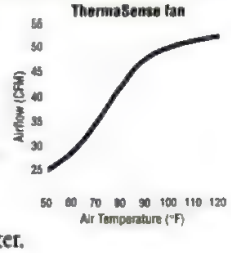

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Windows Utilities

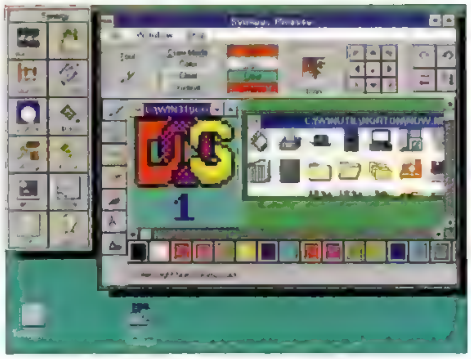
Creative Ideas Make Synergy Stand Out

BY BARRY SIMON

Synapps Software's $129.95 Synergy, Version 1.0, is more than just another replacement for Windows' Program Manager and File Manager. Several of the utilities included represent new ideas.

One notable utility, Eclipse, lets you make button bars that can float freely and be attached to applications.

SSL, Synergy's batch language, is competitive with other Windows batch languages that have "if/then/else" and "while" constructions.



SHADOWS: *Synergy's icon editor, Picasso, is the best one we've seen.*

Also included:

- Psychic, which runs in the background and tracks the names of the files you open in your Windows applications. When you open a file, Psychic pops up a list of previous files. It's an original idea that works like magic.
- Picasso, the best icon editor we've seen. It lets you edit multiple icons, add raised 3-D effects, and move icons between libraries via drag-and-drop.
- Synappshot, a screen-capture program intended as an adjunct to Picasso.
- FX, a fun special-effects feature for Windows users who want to put shadows behind program windows, have them explode upon launch, and add a variety of sounds to events.
- Audition, a .WAV file player.
- LaunchPad, a Windows scheduler that supports single or recurrent events, sounds, messages, and program launching.
- File Fetch, the one weak component of the package. On an uncached drive with about 5,000 files, it took this file finder 10 minutes to do a search that took 38 seconds in File Manager.

That issue aside, the fresh thinking behind the utilities in Synergy makes it stand out in a crowded market.

- List Price: *Synergy, Version 1.0, $129.95.* Requires: *1MB RAM, 1.4MB hard disk space, Microsoft Windows 3.0 or later. Synapps Software Inc., 2009 178th Ave. NE, Redmond, WA 98052; 206-562-3015; fax: 206-784-7125.*

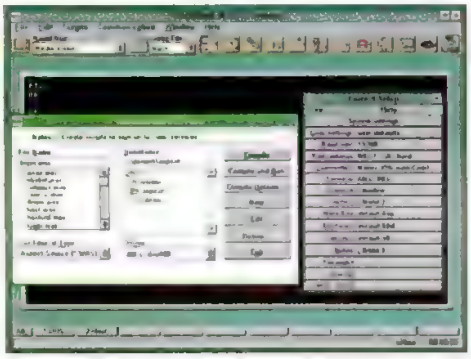
Circle 428 on reader service card

Communications

Windows Calls, Procomm Answers

BY JOHN R. QUAIN

In delaying the introduction of Procomm Plus for Windows (PPW) until Version 3.1 of Microsoft Windows was released, Datastorm used its time wisely. The company has honed its $149 modem communications package to take full advantage of the GUI interface, and it includes all the features of its popular DOS precursor and more.



GUI COMM: *Procomm for Windows maintains commands from the DOS version.*

With a top speed of 115.2 Kbps, PPW includes over 200 predefined modem settings and 34 terminal emulations. All the popular communications protocols are still covered, including Kermit, CompuServe B+, and Zmodem.

In tailoring PPW for the Windows environment, Datastorm has stitched together a variety of GUI techniques. In addition to the standard pull-down menus and dialog boxes, there's a toolbar for uploading and downloading files, initiating screen captures, and launching scripts. The dialing directory has been expanded, and a window builder and a dialog box editor have been incorporated.

Hands-on tests demonstrated PPW's flexibility. You can store global default settings and assign special parameters to individual numbers. During dial-ups and connections, Procomm's status displays are especially helpful.

The Windows version of Procomm also helps to simplify on-line sessions. Its implementation of Zmodem, for example, automatically initiates a download and performs accurate crash recovery whenever transmissions are interrupted.

A particular strength is Procomm's scripting language, ASPECT, which has been expanded for Windows. It now supports DDE, DDL, and asynchronous tasking (the ability to run multiple operations concurrently).

For all its good graces, Procomm does contain a few incidental annoyances. It doesn't include its own editor, but relies instead on Notepad, which can't handle large files. (You can select your own editor.) And there is no option to turn off the modem speaker.

Though Crosstalk for Windows is still the simplest comm program to navigate, Procomm Plus for Windows' capabilities will make it the first choice for Windows power users.

- List Price: *Procomm Plus for Windows, Version 1.0, $149.* Requires: *640K RAM, 3MB hard disk space, Microsoft Windows 3.0 or later, modem. Datastorm Technologies Inc., P.O. Box 1471, Columbia, MO 65205; 800-326-4999, 314-443-3282; fax, 314-875-3063.*

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Q: What do Windows and OS/2 have in common?

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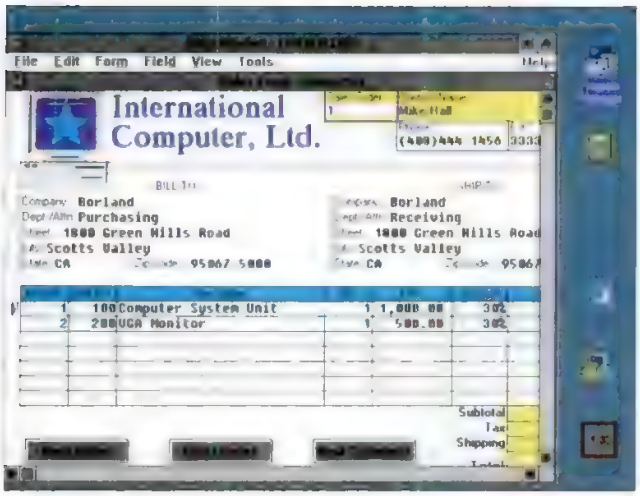
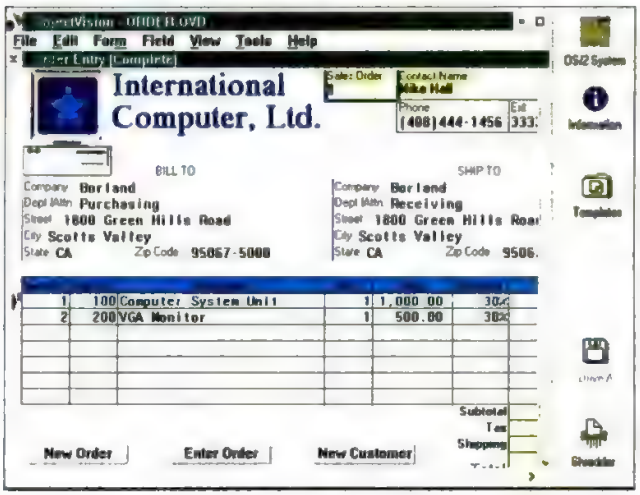


ObjectVision for Windows



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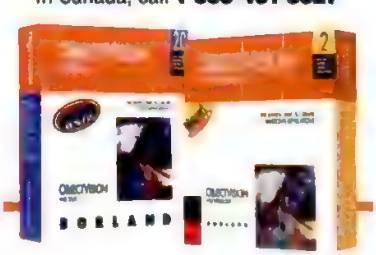

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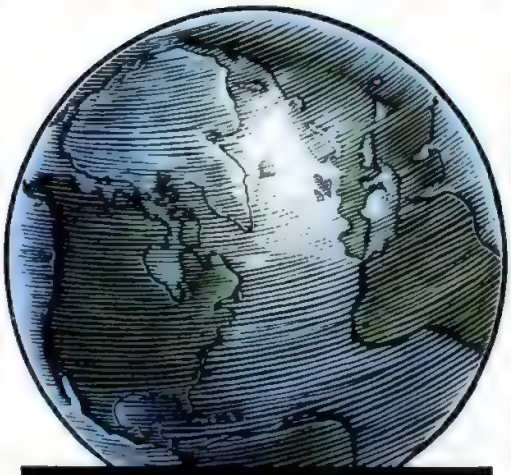

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COMPLETE this coupon, ATTACH a copy of your sales receipt (or a copy of purchase order and billing invoice) AND ENCLOSE $9.00 U.S. for shipping and handling (check or money order payable to Borland International, Inc.).

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*Offer good in U.S. and Canada only on dBASE IV v1.5 purchases between June 1 and September 30, 1992. Only original coupons will be accepted. No responsibility is assumed for lost, late, misdirected, or destroyed mail. Please allow 4–6 weeks for delivery. Subject to all local, state, and federal regulations. Void where prohibited. Offer not valid for Upgrades, Competitive Upgrades, LAN Packs, Volume Packs, or any other Borland promotion except dBASE IV v1.5 products. Distributors and resellers not eligible to participate. Central Point is a registered trademark of Central Point Software.

BORLAND

dBASE IV from Ashton-Tate, a Borland Company

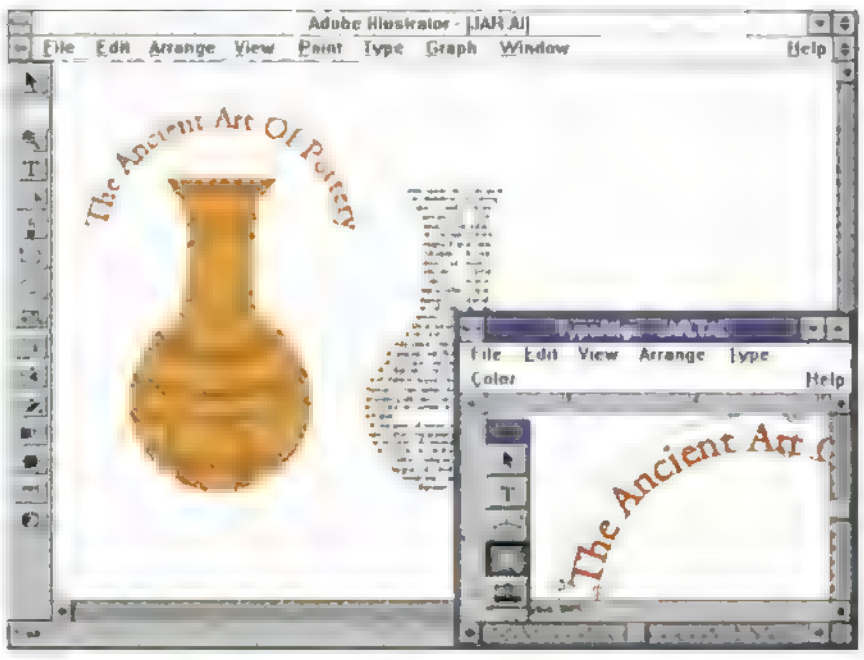
CIRCLE 285 ON READER SERVICE CARD

Graphics

Adobe Illustrator 4.0 Adds Precision Drawing Tools

BY LUISA SIMONE

Adobe Illustrator for Windows, Version 4.0, is a graphics program with a mission. This $695 product sets out to prove that professional artists are less impressed by automated special effects than by high-level drawing controls.



STAY INSIDE THE LINES: *Adobe Illustrator offers many unique functions, including the ability to fill an irregularly shaped object with text.*

Don't misunderstand: Adobe Illustrator is a full-featured drawing program capable of producing complex pictures. There are tools for straight lines, Bezier curves, free-form shapes, scalable type, and primitives such as circles and rectangles, as well as image-editing functions including resize, mirror, rotate, and blend.

But Illustrator doesn't have its competitors' automated functions, such as CorelDRAW's simulated perspective or the warping functions of Arts & Letters.

To understand this point more clearly, examine the program's type effects. Illustrator can align text along an irregularly shaped path, wrap text around objects, and even wrap text *inside* objects. But it doesn't let you manipulate the bounding box that surrounds text—an essential feature if you want to distort the shape of an entire word easily. (Adobe Systems minimizes this shortcoming by bundling TypeAlign, which provides many of the text effects Illustrator lacks.)

On the other hand, experienced artists will appreciate the fact that even the most basic drawing tools provide an extra level of functionality. For example, the sizing tool lets you work with great precision when resizing one object in relation to another, and there are plenty of editing options for Bezier curves. In addition to the normal procedures involving nodes and tangent points, you can change an object's shape by manipulating the actual curve segment.

FLEXIBLE INTERFACE

Even the program's interface provides a lot of flexibility. You can work in either a full preview or wireframe mode, change the size and position of the toolbox, and keep up to 20 documents open simultaneously.

On a more advanced level, Illustrator lets you convert any collection of objects or lines into page guides. Instead of the traditional horizontal or vertical orientation, you can use perspective grids and even curved shapes as guidelines. And Illustrator lets you do more than merely define an image as a pattern. You can rotate, scale, and skew any pattern independently of the object it fills. The program ships with 300 patterns, borders, textures, and symbols culled from Adobe Collectors Editions.

Even a function such as data-driven charting, which at first glance seems rather simple, ultimately proves to be positively elegant. Entering numerical data into a spreadsheet module to create bar, pie, area, and scatter graphs is straightforward. But if you're willing to invest the time, you can learn to use any image as a pictograph in the charts that you create.

One of Illustrator's biggest selling points is its focus on PostScript and high-resolution output. Illustrator's native .AI file format—a subset of PostScript—is an increasingly popular standard. Illustrator can import both vector (.CGM, .DRW, .WMF) and raster (.BMP, EPS, .PCX, TIFF) files, and other programs can read and write to the .AI format directly.

Illustrator is so dependent on PostScript typefaces that it currently recognizes only Adobe Type 1 fonts. It supplies 27 typefaces in addition to the 13 fonts in Adobe Type Manager. Popular type designs such as Adobe Garamond, Tekton, and Wood Type Ornaments are a valuable bonus.

Illustrator even improves on the Windows environment by writing PostScript files (instead of Windows Metafiles) to the Clipboard. This lets Illustrator save Bezier curves and masked images to the Clipboard. However, the target program will be unable to import the image unless it also supports PostScript on the Clipboard.

Most important, Illustra-

Add Autotracing with Streamline

When you buy Adobe Illustrator, you get minimal autotracing functions that are basically a subset of the program's freehand drawing tool. But for a limited time, Adobe is bundling Illustrator together with Streamline, a $195 standalone tracing program. (Call Adobe for the exact dates of this special offer.)

Like most other autotracing programs, Streamline converts bitmapped images into vector-based drawings using either the Centerline or Outline tracing method. You can adjust the accuracy of the trace, choose to ignore stray pixels, and control the proportion of curved lines to straight lines.

Streamline distinguishes itself from the competition by offering both preprocessing and postprocessing functions. Before you begin a trace, for example, you can use the pencil, eraser, and magic wand tools to clean up the image. Best of all, the Color Setup dialog box lets you determine the number of colors—2, 4, 8, 16, 64, or 256—in the final line drawing.

tor concentrates on solving the problems associated with high-resolution output. It writes ASCII (as opposed to binary) PostScript files and supports only those color models used on a printing press, including CYMK, Pantone, and Trumatch. Illustrator also bundles a utility, Adobe Separator, that generates four-color separations complete with optimized line screens, traps, chokes, and dot gain compensation.

ROOM TO IMPROVE

For all its strengths, Illustrator could be better. Its emphasis on "power user" features is sure to intimidate novices. The toolbox contains 40 functions, 4 of which are selection tools. Learning to distinguish between them is at best hard work, and at worst very confusing. And functions such as masking and defining a pattern will be difficult for the occasional user to master.

Though the program is identical to its Macintosh sibling, to compete with the big-time PC-based illustration products (like CorelDRAW or Micrografx Designer) Illustrator needs a true gradient fill (now you must use the blend tool to generate intermediate shapes and colors) and the ability to define calligraphic characteristics for lines. And there is also no way to save attributes as a style or to copy styles from one object to another.

Despite these faults, this second attempt to port the very popular Mac product to the PC is exciting. Illustrator offers the functionality that a mature PC-based illustration market needs: precise drawing tools and bulletproof PostScript output.

• List Price: *Adobe Illustrator for Windows, Version 4.0, $695.* Requires: *386-based PC or better, 4MB RAM, 12MB hard disk space, Microsoft Windows 3.0 or later, Adobe Type Manager. Adobe Systems Inc., 1585 Charleston Rd., Mountain View, CA 94039; 800-833-6687, 415-961-4400.*

Circle 423 on reader service card

Of course, you can import the traced outlines into Illustrator for further enhancement, but you can also use Streamline's postprocessing functions to delete unnecessary curve nodes, generate smoother outlines, and change the color or the stroke of objects. This, coupled with the ability to write standard file formats (such as .CGM, .DRW, EPS, and .WMF), makes it possible to export Streamline drawings directly into desktop publishing or presentation graphics programs.

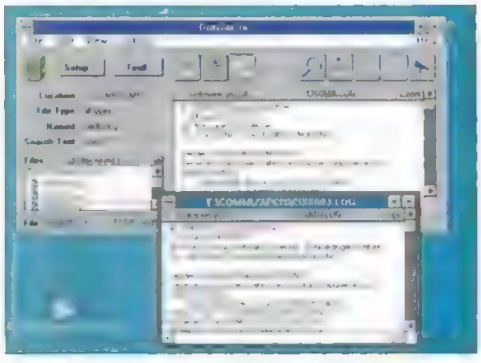
Our testing revealed several limitations. The program uses an uneditable 256-color palette to distinguish the colors in the source file. Tracing a monochromatic, low-contrast image yields unsatisfactory results. In addition, the program requires at least 30 contiguous pixels of the same color in order to recognize a discrete shape, which results in some posterization. Despite these limitations, anyone who regularly converts bitmapped pictures into object-oriented drawings will find Streamline a flexible, powerful, and accurate autotracing utility.—*LS*

Utilities

Outside In Builds a Bridge Between DOS and Windows Worlds

BY BARRY SIMON

Windows isn't very open-minded when it comes to viewing files from non-graphical programs, so it becomes difficult to reuse data that already exists in your text-based word processor, spreadsheet, or database. This weakness leaves the door wide open for Outside In for Windows, Version 1.0, an $89 utility from Systems Compatibility Corp., that could turn out to be an essential tool for Windows users.



SUPER VIEWER: *Outside In for Windows includes a special find mode and tear-off windows to allow access to multiple files.*

The core of Outside In is an impressive array of file viewers for more than 75 file formats. By linking up with the Windows Clipboard, the program lets you select a file or section of a document, send it to the Clipboard, and paste it into your word processor.

The material is exported to the Clipboard in a format that's readable by many different Windows programs. The document's spacing, justification, and font size are retained, although specific fonts are not preserved.

Outside In conveniently prints files or parts of files. Bold and italics are retained, but font size, type, and justification are not. Another convenience: Whenever you view a file, you can launch the associated application and go right to work on it.

Outside In also lets you search on filenames or text strings, returning a list of files to look through. You can "tear off" any file view and leave it as an icon on the desktop.

While a strong first version, Outside In has its flaws. It doesn't support graphics files or compressed files, and wide spreadsheets and databases are problematic. The program should also be able to search files that are torn off, not just displayed files.

Despite these irksome restrictions, Outside In is one data-maintenance utility that serious Windows users will truly appreciate.

• List Price: *Outside In for Windows, Version 1.0, $89.* Requires: *1.4MB hard disk space, Microsoft Windows 3.0 or later. Systems Compatibility Corp., 401 N. Wabash, #600, Chicago, IL 60611; 800-333-1395, 312-329-0700; fax, 312-670-0820.*

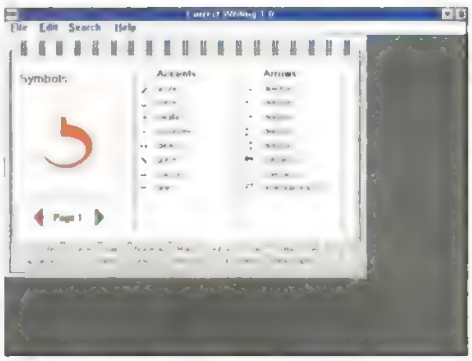
Circle 425 on reader service card

■ Software

Correct Series and Instant Answers Help Prevent Sloppy Writing

BY RUBIN RABINOWITZ

You don't have to be an English major to be a good writer. Sometimes just knowing the correct format for a business letter or using an accurate quotation can make the difference between sloppy and polished. Here are two reference packages that offer guidance in effective business writing.



SYMBOLISM: *Correct Writing lets you click on a notebook tab for a particular category of information.*

CORRECT WRITING, CORRECT LETTERS, AND CORRECT QUOTES

WordStar's Correct group includes a style manual, a collection of business letters, and a quotation dictionary.

Correct Writing for Windows ($69, or $59 for the DOS version) is a style manual that uses a notebook as a visual metaphor. There are sections on punctuation, spelling, compound words, italics, footnotes, bibliographies, tables of contents, indexes, mathematical equations, proofreader's marks, abbreviations, symbols, and metric conversion. There is even a collection of adjectival forms used for Americans, so you can know what to call a person from Connecticut.

Correct Writing's coverage of punctuation is comprehensive, but it offers only skimpy advice on grammar and style.

A companion program, Correct Letters ($59 for Windows, $49 for DOS), touches on grammar and style, but the main feature is a collection of 250 model letters for use in sales, marketing, public relations, customer service, credit, and collection. The Windows version lets you export letters to Windows word processors or to the Clipboard. You can also export the letters as ASCII files.

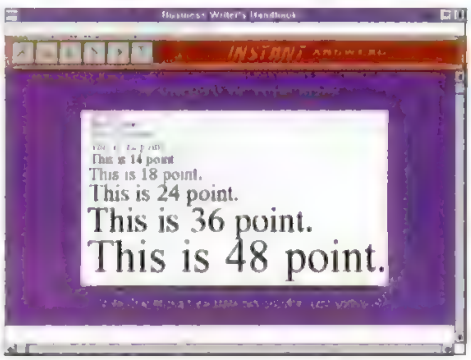
Correct Quotes ($59 for Windows, $49 for DOS) offers 5,000 quotations from "the world's wittiest poets and pundits." While it hardly rivals the printed *Bartlett's Quotations* (117,000 items) or the condensed *Bartlett*'s in Microsoft Bookshelf (22,000 items), Correct Quotes is comparable to programs such as Wisdom of the Ages (6,500), The Concise Columbia Dictionary of Quotations (6,000), and Quotemaster Plus (5,000). Arranged alphabetically under 600 topic headings, Correct Quotes lets you print quotations or copy them to the Windows Clipboard or to an ASCII file.

INSTANT ANSWERS

Reference Software's Instant Answers is a set of four modules: The Associated Press Stylebook, the Business Writer's Handbook, the Complete Secretary's Handbook, and the Financial Mathematics Handbook. They cost $59 each, or $179 for all four.

The Associated Press Stylebook is an on-line version of the familiar journalist's handbook. Its main section gives advice for an alphabetical list of topics, from "a/an" to "ZIP codes." It also covers punctuation, business and sports writing styles, bibliography formats, and copyright laws. The program is particularly good at helping you find answers quickly: You can scroll through a table of contents or index, or search the index or the entire text.

The Business Writer's Handbook, a specialized style manual for business, covers grammar, punctuation, mechanics, spelling, diction, desktop publishing, letter writing, and report and research paper preparation. There are glossaries of computer terms and foreign expressions, a short quotation dictionary, and information on abbreviations, misspelled and confused words, as well as reference sources.



ANSWERS: *This Instant Answers lesson on type sizes is from the Business Writer's Handbook.*

The Complete Secretary's Handbook includes some material already covered in other modules: a style guide, a letter writing guide, and a list of abbreviations.

The Financial Mathematics Handbook explains annuities, interest and discount formulas, loan calculations, and asset depreciations, and includes an appendix that explains Lotus 1-2-3's financial functions.

The Correct and Instant Answers collections will save you a lot of searching through texts. They're easy to learn and will end some nagging questions such as, What do you call a person from Connecticut? A Connecticuter, of course.

• List Price: *Correct Writing for Windows, $69; for DOS, $59. Correct Letters for Windows, $59; for DOS, $49. Correct Quotes for Windows, $59; for DOS, $49. WordStar International Inc., 201 Alameda del Prado, P.O. Box 6113, Novato, CA 94949; 800-523-3520, 415-382-8000.* Requires: *For Windows versions: 3.4MB hard disk space, Microsoft Windows 3.0 or later. For DOS versions: 55K RAM, DOS 3.0 or later.*

Circle 402 on reader service card

• List Price: *Instant Answers, $59 each; all four, $179. Reference Software International, 330 Townsend St., San Francisco, CA 94107; 800-872-9933, 415-541-0222; fax, 415-541-0509.* Requires: *For Windows versions: 2.9MB hard disk space, Microsoft Windows 3.0 or later. For DOS versions: 55K RAM, DOS 3.1 or later.*

Circle 403 on reader service card

Ambulance Car Virus. Ambulance randomly moves across bottom of display.

Friday 13th Virus. Alias "Black Friday." Erases programs when you try to run them.

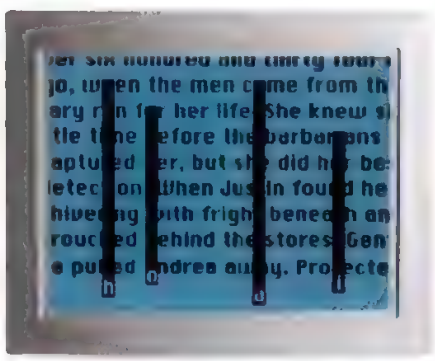
Disk Killer Virus. Alias "Ogre." Causes unexpected formatting of your hard disk.

Stoned Virus. Alias "Hawaii." Data loss caused by damage to directory and FAT.

Datacrime Virus. Adds garbage to files and reformats disk.

AirCop Virus. Alias "Red State." Attacks boot sector on non-write-protected diskettes.

Ping Pong Virus. Alias "Bouncing Ball." Wipes characters off the screen.



Falling Letters Virus. Characters fall to the bottom of the monitor. Creative, but a real nuisance.

With over 50 new viruses each month, who knows what's next.

You Could Get By Without An Anti-Virus Program. Then Again, So Could These.

These days, with networks, modems, laptops, and more and more people sharing files, it's only a matter of time before a virus attacks your data.

PC MAGAZINE EDITORS' CHOICE Oct. 29, 1991 CPAV. 1.0

To make sure you get them before they get you, you need Central Point Anti-Virus.™ The only anti-virus program with File Immunization that protects your files so they can never be infected again. Central Point Anti-Virus detects over 1200 viruses and destroys twice as many viruses as other programs. It'll even protect you from unknown viruses by searching for suspicious behavior.

Central Point Anti-Virus offers both Windows and DOS versions, and it works great across your Novell network.

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If you want the most complete virus protection, there are really only two things you can do. Call **1-800-445-4038** for more information. Or unplug your computer.

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Making Computing Safer, Simpler, Faster.

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CIRCLE 079 ON READER SERVICE CARD

WINDOWS

Let's face it. Any connectivity software can connect your PCs to your mainframe. But EXTRA!™ for Windows can actually enhance your return on investment by helping your business become more competitive. Here's how.

Improves individual productivity

People work quickly with EXTRA! for Windows because it's optimized for fast operation in every area. It's easy to access information. File transfers are super-quick. And, since it's from Attachmate, you can count on reliable performance and uncompromising support ▮ No wonder EXTRA! for Windows won *PC Week*'s "Shootout" of Windows-based connectivity software, and has received international recognition as the "Best 3270 Emulator for Windows."*

WINNER PC WEEK LABS SHOOT-OUT

WINDOWS D'OR

The EXTRA! for Windows edge

For a business to be competitive in the 90s, it needs to protect its current investments, improve individual productivity, and successfully anticipate change ▮ EXTRA! for Windows gives you an edge in all three areas, thanks to its advanced technology, built-in anti-obsolescence, and Attachmate®'s connectivity experience.

Can you afford cheap connectivity software?

Anticipates change

Who knows what new operating systems and standards will emerge in the world of mainframes and PCs? With EXTRA! for Windows it simply doesn't matter. Paths to new operating systems are built in, and EXTRA! for Life protects you from having to buy new programs if you switch platforms ▮ What's more, EXTRA! for Windows incorporates efficient protocols for inter-networking. And if you're moving to client/server computing, you'll also find the tools in EXTRA! to help ease the migration.

Protects your current investments

First of all, EXTRA! for Windows complies with IBM® standards, so it will work with your IBM system—now and into the future. Its *Universal Connectivity* lets you choose a coax or LAN connection. And if you ever need help, the call and the support are available at no charge ▮ Then there's our unique "EXTRA! for Life" upgrade policy. It lets you move easily to a new version of EXTRA! on the same *or different* PC platform. For instance, an owner of EXTRA! Extended™ for DOS can upgrade inexpensively to the latest release of EXTRA! for DOS—*or* to EXTRA! for Windows.

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CIRCLE 270 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Emerson Andrew Torgan

NEW

How Low Can You Go? Dell Shows Off 3.6-Pound Notebook

They're called "subnotebooks" and they weigh about 3 or 4 pounds. **Dell Computer Corp.** now has such a system, but don't call it a subnotebook; Dell prefers the phrase "Super-Portable Notebook System."

The Dell System 320SLi is a 386SL-based notebook PC that runs at 20 MHz and weighs a mere 3.6 pounds with battery. It employs a 9.5-inch reflective TSTN (triple super-twisted nematic) monochrome LCD that uses 75 percent less power than traditional edgelit LCDs, provides an equivalent 12:1 contrast ratio, allows up to 640-by-480 resolution, and supports up to 64 shades of gray. The lower power consumption of the new LCD, developed by Dell and Sharp Electronics, allows the use of smaller and lighter batteries. Battery life ranges from 3 to 5 hours, according to the manufacturer.

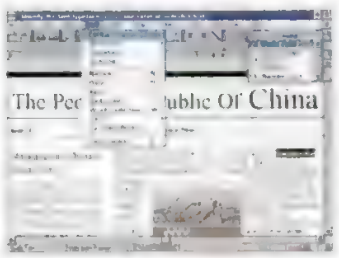
PHOTOGRAPH BY THOM O'CONNOR

Dell's 320SLi won't weigh you down.

The Dell System 320SLi is priced starting at $2,149 for a unit configured with 2MB of RAM (expandable to 10MB), a 1.44MB 3.5-inch external floppy disk drive, a PCMCIA 2.0 slot (capable of accepting Dell's 2,400-bps Lightpack modem), and a 60MB hard disk with DOS 5.0 and Windows 3.1 preinstalled. Units with hard disk configurations of 80MB and 120MB are priced at $2,349 and $2,649, respectively.

• List Price: *The Dell System 320SLi, $2,149. Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-338-8421.*
Circle 405 on reader service card

HOT PROSPECT



Ami Pro 3.0 Moves In On Word for Windows

Lotus Development Corp. brings Ami Pro closer to Microsoft's Word for Windows with such features as fast formatting, drag-and-drop, improved mail-merge, and envelope printing. The new version of this Editors' Choice–winning Windows word processor (an honor it shared with Word for Windows in the February 25, 1992, issue) retains its superior graphical and WYSIWYG capabilities. Ami Pro 3.0 provides users with more options for completing tasks and reducing the number of required steps. It also promises to be significantly faster than Ami Pro 2.0.

The new Fast Format feature lets you repeat text formatting with the mouse. Simply select the text; choose options such as bold, italic, and font; and click on the Fast Format option. Any text you select will then be formatted identically. The SmartMerge feature is smarter still, utilizing a cardfile approach in creating and editing merged data files. Envelope printing, including a selection of standard envelope sizes, is also new.

• List Price: *Ami Pro, Version 3.0, $495; upgrade from previous version, $129. Lotus Development Corp., Word Processing Division, 1000 Abernathy Rd., Bldg. 400, #1700, Atlanta, GA 30328; 800-831-9679, 404-391-0011; fax, 404-698-7653.*
Circle 404 on reader service card

NEW

FrameMaker 3.0: Page Layout, Word Processing, and More

Originally a Unix package that was ported to the Macintosh platform, FrameMaker document publishing software is now available for the PC. FrameMaker 3.0 for Windows combines WYSIWYG word processing, graphics, page layout, structured document building, tables, conditional text, and equation editing in a single application.

FrameMaker for Windows supports the Windows Multiple Document Interface (MDI), which lets users work with multiple documents in a single session, and the Modeless Dialog features, which let users see changes as they are made without closing dialog boxes. It imports over 30 text and graphics file formats and supports OLE (object linking and embedding). Files created in FrameMaker 3.0 for Windows are fully cross-platform-compatible with both the Unix and Macintosh versions of FrameMaker 3.0.

• List Price: *FrameMaker 3.0 for Windows, $795. Frame Technology Corp., 1010 Rincon Circle, San Jose, CA 95131; 800-843-7263, 408-433-3311; fax, 408-433-1928.*
Circle 406 on reader service card

NEW

Compaq Unveils New Active-Matrix Black-and-White Display

Compaq Computer Corp.'s 17.2-pound portable PC is designed to provide superior "on-the-road" screen quality for users who don't need a color display. The Compaq Portable 486 Model 120 has an active-matrix TFT (thin-film transistor) black-and-white display that offers high contrast and sharp images in 64 shades of gray at 320-by-200 resolution.

The EISA-based, AC-powered 486DX system runs at 33 MHz and provides two full-size 32-bit expansion slots. The Model 120 is available in standard configuration with 4MB of RAM (expandable to 32MB), a

1.44MB 3.5-inch floppy disk drive, a 120MB hard disk, a full-size detachable keyboard, and Compaq's Multilock security features (consisting of 14 different hardware and software tools).

PHOTOGRAPH BY THOM O'CONNOR

Compaq's Model 120 has a high-contrast display.

• List Price: *Compaq Portable 486 Model 120, $5,899. Compaq Computer Corp., 20555 State Highway 249, Houston, TX 77070; 800-345-1518, 713-370-0670.*
Circle 407 on reader service card

IMPROVED

WordPerfect's Interim Release Squashes Bugs, Adds Features

There's good news for all of you who use WordPerfect for Windows, Version 5.1. **WordPerfect Corp.** is shipping a $15 interim release of the Windows word processor that not only corrects the display, printing, and Windows Metafile graphics bugs, but adds a host of new items such as drag-and-drop and zoom edit. The new disks are dated April 30, 1992, and are optimized for Windows 3.1, according to the company.

A bullet macro, an envelope macro, macro dialogs, and on-line macro help complement the new macro command inserter program. Support for Windows DDE (dynamic data exchange) is improved with a new DDE Execute capability that enables DDE-compliant applications to execute WordPerfect commands. Additional features include remappable alphanumeric keys, improved table math, and improved graphics import capabilities.

• List Price: *WordPerfect for Windows, Version 5.1 (interim release), $495; update to WordPerfect for Windows, Version 5.1, $15 (plus shipping and handling; call WordPerfect's Order Department at 800-321-4566). WordPerfect Corp., 1555 N. Technology Way, Orem UT, 84057; 800-451-5151, 801-225-5000; fax, 801-222-5077.*
Circle 408 on reader service card

BRIEFS

Portable PCs

Acma is shipping a 386DX/33 notebook ($2,299) with 4MB of RAM (expandable to 16MB), a 32K cache, a 1.44MB 3.5-inch floppy disk drive, and a 100MB hard disk. 800-456-1818, 510-623-1212; fax, 510-623-0818.

Commax Technologies' LightWave notebook PC features a 486DX/33 processor and is available with 4MB of RAM, a 1.44MB 3.5-inch floppy disk drive, and either an 80MB ($3,395) or 120MB ($3,695) hard disk. 800-526-6629, 408-435-5000; fax, 408-435-5005.

Ergo Computing's NoteBrick ($3,695) has a 486DX/33 unit. It is available with 4MB of RAM, a 1.44MB 3.5-inch floppy disk drive, and a 170MB hard disk. A 120MB hard disk is also available. 800-633-1925, 508-535-7510; fax, 508-535-7512.

Identity Systems Technology has unveiled the Identity 386SXL-25 notebook PC ($3,295), powered by the AMD 386SXL/25 processor running at 25 MHz. It ships in standard configuration with 4MB of RAM, a 1.44MB 3.5-inch floppy disk drive, and a 213MB hard disk. 214-236-3330; fax, 214-907-9227.

NoteBook Computer is shipping the Model T50 486NoteBook, which features a 486DX2 processor. The unit ships in standard configuration with 4MB of RAM and an 80MB ($5,599) or 120MB ($5,899) hard disk. An optional 1.44MB 3.5-inch external floppy disk drive is available. 713-939-0486; fax, 713-939-1486

QSI has unveiled the Klonimus Lite 386SL notebook computer. The unit has a 1.44MB 3.5-inch floppy disk drive and is available in several different RAM and hard disk configurations. 718-834-4545; fax, 718-834-5318.

NEW

First 66-MHz System Has Surprising Price Tag

Fountain Technologies, one of the first PC vendors to announce a speed-doubled 66-MHz 486 system, has priced it at a surprisingly low $2,995. The Fountain 486/66 DX2 comes with 8MB of RAM and a 256K secondary cache, a 200MB hard disk, two floppy disk drives, one parallel and two serial ports, a 14-inch Super VGA monitor and a graphics accelerator card, a mouse, DOS 5.0, and Windows 3.1.

Since overheating of the processor is a problem, the system is equipped with a small fan that sits directly on top of the chip. Unfortunately, the presence of the fan makes it impossible to insert full-length expansion cards in three slots.

PHOTOGRAPH BY THOM O'CONNOR

Fountain's speed-doubled 486/66 DX2.

• List Price: *Fountain 486/66 DX2, $2,995. Fountain Technologies Inc., 50 Randolph Rd., Somerset, NJ 08873; 908-563-4800; fax, 908-563-4999.*
Circle 409 on reader service card

NEW

Video Blaster: Full-Motion Video For Less than $500

Creative Labs, maker of the popular Sound Blaster audio card, has unveiled Video Blaster. The new unit lets users display, edit, and capture frames from full-motion video on any compatible PC.

Video Blaster combines video from NTSC or PAL video sources (such as video cameras, VCRs, or videodisk players) with PC graphics and animation. The resulting images can be captured and saved into a number of popular graphics file formats (.BMP,

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CIRCLE 141 ON READER SERVICE CARD

EPS, and .TGA), edited, and exported to other applications. The unit is bundled with VBVIDEO for frame captures and zoom and audio control, Mathematica's Tempra multimedia authoring system, and MMPLAY presentation software.

• List Price: *Video Blaster, $495. Creative Labs Inc., 1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227, 408-428-6600; fax, 428-6611.*

Circle 410 on reader service card

NEW

Pinnacle Micro Ships High-Speed Optical Drive

Pinnacle Micro's PMO-650 is a 650MB rewritable optical disk drive that uses a proprietary OHD (optical hard drive) mechanism. The split optic design creates a light optic head, providing a high rotation speed (3,600 revolutions per minute) and a fast seek time of 19 milliseconds, according to the company.

The plug-and-play unit can replace existing hard disks for data storage and employs a direct seek method, eliminating one step in the data seek process. The PMO-650 has an 80188 processor running at 20 MHz for strategic mapping, and data queuing on reads and writes for more efficient throughput.

• List Price: *PMO-650, $4,195. Pinnacle Micro, 19 Technology, Irvine, CA 92718; 800-553-7070, 714-727-3300; fax, 714-727-1913.*

Circle 411 on reader service card

NEW

Texas Instruments and Wyse Roll Out New 486 Notebooks

Texas Instruments has three new 486-based additions to the TravelMate series of notebooks in 486SX and 486DX configurations. The TravelMate 4000 WinSX/16 offers 4MB of RAM (expandable to 8MB), 512K of VRAM, and an 80MB hard disk. The TravelMate 4000 WinSX/25 and WinDX/25 each offer 4MB of RAM (expandable to 20MB), 1MB of VRAM, and a 120MB hard disk. Each of the new TravelMates weighs less than 6 pounds, is configured with an internal 1.44MB 3.5-inch floppy disk drive and a TravelPoint pointing device, and ships with DOS 5.0 and Windows 3.1 preinstalled.

BRIEFS

Accounting and Finance

Central Computer Products is shipping Do-It-Yourself Accounting ($69.95), which offers General Ledger/Checkbook, Accounts Receivable/Billing, Accounts Payable/Checkwriter, and Inventory Control, as well as Payroll for all 50 states. 800-465-4123, 805-524-4700; fax, 805-524-4026.

CTS has released the 80-page *1992 Accounting Software Survey* ($79 plus $5 shipping and handling), which rates the leading PC-based accounting packages including ACCPAC PLUS, MAS90, Platinum, and Macola. 800-433-8015, 308-468-4800; fax, 301-468-2309.

Hamilton Software's The Investor's Accountant 2.0 is a PC-based investment management system that combines portfolio management with investment analysis. The new version includes simulated "what if" scenarios, time-weighted internal rate of return calculations for each investment, single-entry editing, and a portfolio income/cash activity report. 800-733-9607.

Nestor has unveiled The Business Consultant and Financial Analyst ($249.99), a software program that analyzes a company's historical financial information, current business statistics, and future plans. The package creates reports including cash-flow analysis, cash-flow projections, break-even analysis, and ratio analysis. 801-483-9040; fax, 801-483-9041.

Savant Software is shipping TopVest ($3,500), an investor's workstation software package for technical and fundamental analysis of equities and other securities. TopVest provides multiwindowed charting using more than 100 indicators, including Fourier, adaptive filtering, automatic trendlines, Japanese candlesticks, point and figure, and equivolume. 800-231-9900, 603-471-0400.

Wyse Technology's DecisionMate 486SLC is one of the first notebook PCs to utilize the 386SX pin-compatible Cyrix Cx486SLC/25 processor running at 25 MHz. The 5-pound (with battery) system is configured with 4MB of RAM (expandable to 8MB), an external 1.44MB 3.5-inch floppy disk drive, an 8.5-inch LCD screen, and an 80MB hard disk. The system is also available with 4MB of RAM and a 120MB hard disk ($2,699).

PHOTOGRAPH BY THOM O'CONNOR

The Texas Instruments TravelMate 4000 WinSX/25 (right) and the Wyse DecisionMate 486SLC.

• List Price: *TravelMate 4000 WinSX/16, $3,199; TravelMate 4000 WinSX/25, $3,799; TravelMate 4000 WinDX/25, $4,399. Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720; 800-527-3500, 817-771-5856.*

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• List Price: *DecisionMate 486SLC, $2,299. Wyse Technology, 3471 N. First St., San Jose, CA 95134; 800-438-9973, 408-473-1200; fax, 408-473-2080.*

Circle 413 on reader service card

IMPROVED

Diagnostic Software That Shows You Where It Hurts

American Megatrends' enhanced version of its PC diagnostic utility now sports a new color graphical interface and auto-interleave testing. AMI Diag, Version 4.0, analyzes system boards, memory, and peripherals. The package displays a graphical representation of the motherboard, enabling users to pinpoint the location of defective DRAM and SIMM chips. The results can be printed or logged to a disk. Users can also tailor their own tests and reports.

AMI Diag 4.0 includes tests for the hard disk, the floppy disk drives, for processor speed, and for the I/O interfaces, as well as

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CIRCLE 127 ON READER SERVICE CARD

memory, component, and keyboard tests. It also provides system configuration and benchmark testing.

• List Price: *AMI Diag, Version 4.0, $149. American Megatrends Inc., 6145-F Northbelt Pkwy., Norcross, GA 30071; 800-828-9264, 404-263-8181; fax, 404-263-9381.*

Circle 414 on reader service card

NEW

ColorWorks: High-Quality Color at An Affordable Price

Proxima Corp. has unveiled a low-cost LCD overhead projection panel capable of displaying up to 24,389 colors, according to the company. The 6-pound ColorWorks sx is priced at $3,995 with a 9-inch display.

Instead of an expensive active-matrix panel, ColorWorks uses a unique color-stripe filter technology in a passive-matrix panel, reducing both the cost and weight of the unit. The new addition to the Proxima line of projection panels is compatible with the company's Cyclops interactive pointer system, allowing presenters to control presentation graphics software from the projected image with either the Cyclops wand or a laser pointer.

• List Price: *ColorWorks sx, $3,995. Proxima Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121; 619-457-5500.*

Circle 417 on reader service card

NEW

Is It Remotely Possible to ReachOut to Your Windows?

Two remote-control software packages for Windows, **Avalan Technology**'s Remotely Possible/Dial, Version 1.0, and **Ocean Isle Software**'s ReachOut Network, Version 3.0, are now shipping.

Remotely Possible/Dial includes a Windows DLL (dynamic link library) that interacts with the Windows 3.*x* GDI (graphics device interface) library. By intercepting GDI function calls from Windows applications, the package offers greater control via modem, according to the company. Remotely Possible/Dial supports file transfer and interactive chat between PCs.

ReachOut Network, Version 3.0 (available in network and modem versions), now provides extended DOS control features as well as Windows control. Text and graphics support for CGA, MCGA, Hercules Mono, EGA, VGA, VGA Monochrome, and Windows Super VGA is available, and there are full graphics translations between displays. ReachOut Network now offers a gateway that lets ReachOut Modem users dial into a workstation, then remotely operate other workstations across a network.

• List Price: *Remotely Possible/Dial, Version 1.0, $199. Avalan Technology, 116 Hopping Brook Park, Holliston, MA 01746; 800-441-2281, 508-429-6482; fax, 508-429-3179.*

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• List Price: *ReachOut Network, Version 3.0, $295 for four-node version. ReachOut Modem, Version 3.0, $179. Ocean Isle Software, 49 Royal Palm Blvd., Vero Beach, FL 32960; 407-770-4777; fax, 407-770-4779.*

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BRIEFS

Statistics and Graphing

Jandel Scientific is shipping SigmaPlot 5.0, a 3-D version of its graphing software package. The new version lets users create mesh and scatter plots in 3-D. The 3-D options include hidden line removal, filled and unfilled polygons, frame lines, backplanes with color and grids, and drop lines for scatter graphs. 800-874-1888, 415-453-6700; fax, 415-453-7769

CoHort Software is shipping CoPlot 2.1, CoDraw 2.1, and CoStat 4.1, available at $159 each or $395 for all three. CoPlot lets users create scientific graphs of data equations, offering a choice of 16 different 2-D and 3-D graph types. CoDraw is designed to create technical drawings such as circuit diagrams and genetic maps. CoStat performs statistical analysis of data and can create simple fixed-format graphs. 510-524-9878; fax, 510-524-9199.

SYSTAT is shipping FASTAT 2.0 for DOS ($495), a statistical analysis, data management, and graphics software program. FASTAT analyzes files containing unlimited cases and up to 150 variables per session. It offers such statistical procedures as descriptive statistics, t-tests, frequency distributions, multiway cross-tabulations, and time-series analysis. Basic charts and graphs can be created, as well as box plots, stem-and-leaf diagrams, bivariate plots, 3-D rotating plots, and scatter plot matrices. 708-864-5670.

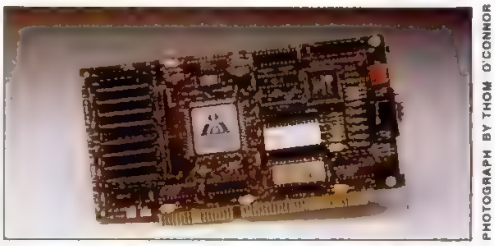
SmoothVision Software is now shipping PointMaster 1.10 ($189), an update of its scientific data visualization software program for Windows that offers data analysis, manipulation, and presentation. It provides users with WYSIWYG graph display, and *x, y,* scatter, histogram, and vector plots, along with simultaneous handling of multiple data sets. 201-652-3839; fax, 201-444-9127.

IMPROVED

Fahrenheit 1280° Gains 24-Bit Color, Extra Speed Boost

Orchid Technology is shipping a new version of the Fahrenheit 1280° Windows accelerator board that provides 24-bit color at 480-by-640 resolution. The enhanced board provides a 7 percent performance gain over the original Fahrenheit, according to the company.

Orchid's proprietary Windows 3.1 software drivers contain a new setup utility that places mode and color selection controls into the Windows Control Panel. A 512K version of the Fahrenheit 1280° is also available and can be upgraded to 24-bit color capability with the addition of VRAM.



PHOTOGRAPH BY THOM O'CONNOR

The Fahrenheit 1280° provides fast 24-bit color.

• List Price: *Fahrenheit 1280° (1MB version), $399; Fahrenheit 1280° (512K version), $329. Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 510-683-0300; fax, 510-490-9312.*

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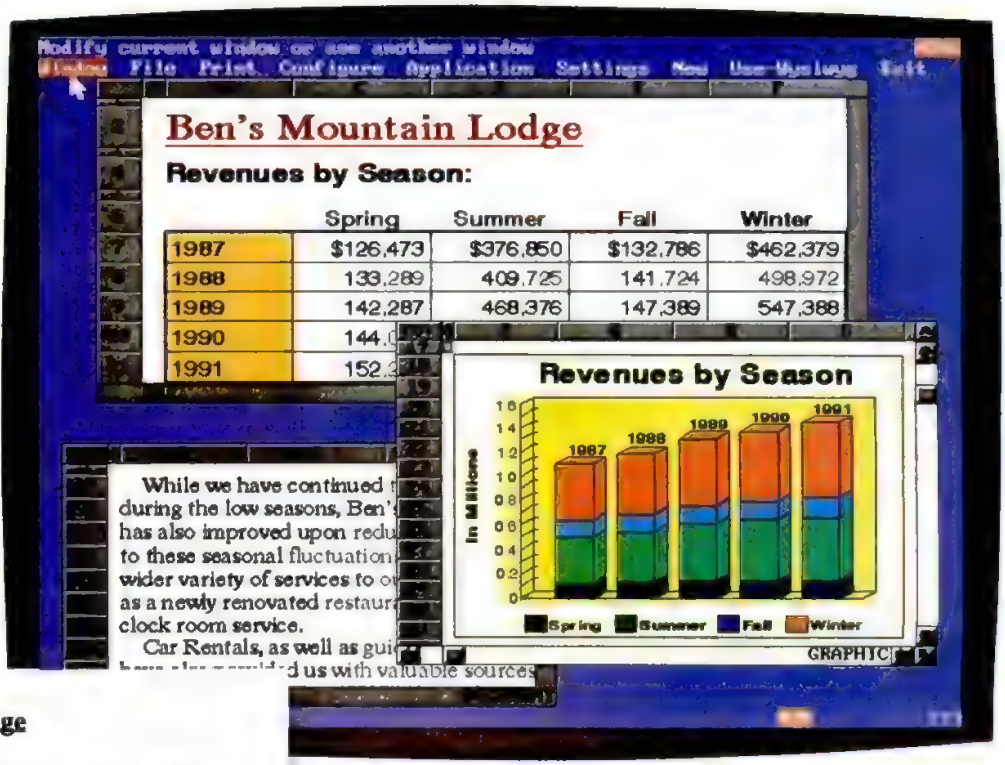


Ben's Mountain Lodge

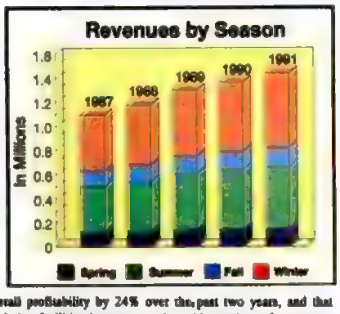
Revenues by Season:

	Spring	Summer	Fall	Winter
1987	$126,473	$376,850	$132,786	$462,379
1988	133,289	409,725	141,724	498,972
1989	142,287	468,376	147,389	547,388
1990	144,090	498,042	151,234	575,876
1991	152,208	511,398	162,398	621,723
1992	153,947	532,684	164,010	630,242
TOTAL	$852,294	$2,797,075	$899,541	$3,336,580
AVERAGE	142,049	466,179	149,924	556,097

While we have continued to increase revenues during the low seasons, Ben's Mountain Lodge has also improved upon reducing its exposure to these seasonal fluctuations by offering a wider variety of services to our customers, such as a newly renovated gourmet restaurant and around the clock room service.

Car rentals, as well as guided tours of the mountains, have also provided us with valuable sources of revenue, making us much less dependent upon high season sources, such as skiing in the winter, and fishing and hiking during the summer months.

Our estimation is that these new sources of revenue have increased our overall profitability by 24% over the past two years, and that other improvements to lodge facilities have attracted a wider variety of customers than we have seen in the past. Our expectation in the long-term is to see even more profitable years at Ben's Mountain Lodge.



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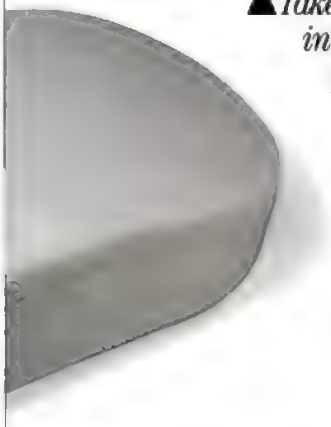

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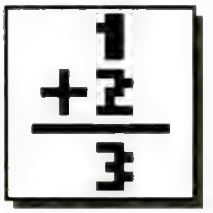
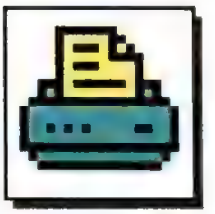


Sum multiple columns and rows.

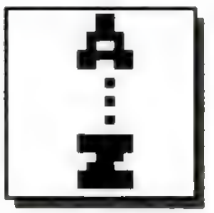
QuickGraph does exactly what it says.



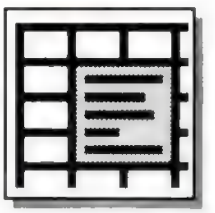
Ready to print? Just click here.

Turn text to bold in one step.

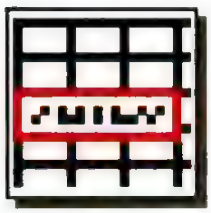
Format your numbers as currency.



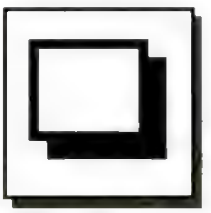
Sort a pre-selected range of data.



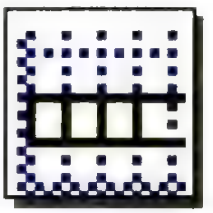
Define and edit a text range.



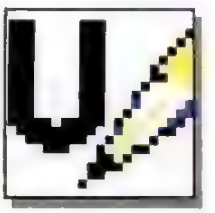
Center text across columns.



Add or delete a drop shadow.



Insert a row wherever necessary.



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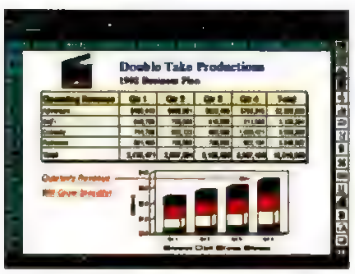

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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

PC Industry Career Guide: Sensible Advice On Turbulent Job Market

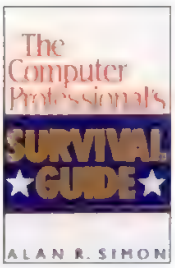
BY ALFRED POOR

Not so long ago, the job market for computer professionals was wide open. You could arrive at a personnel office with little more than typing skills and enthusiasm and land a good job with growth potential. Those days are gone. Degrees in computer science and business management, a long resume, and experience with an industry giant no longer guarantee employment, let alone advancement.

Part of the problem certainly stems from troubled economic times, but the industry has also matured. For those who prefer the relative security of a corporate job, the rules have changed. *The Computer Professional's Survival Guide*, by Alan R. Simon, can help you navigate the changing landscape of the computer industry.

This slim paperback, which takes no more than an evening to read, is likely to change the way you think about your job and your future. In spite of the pessimistic state of the industry—with some big companies announcing shrinking profits and staff reductions—Simon manages an upbeat tone. The book echoes the basic tenet of all career planning: If you know what you want and prepare carefully, you can improve your chances of success.

Simon covers the history of the computer job market, education options, and alternative careers, and offers advice on resumes and interviews. More than a third of the book is devoted to descriptions of over 20 types of computer careers and the outlook for each. In keeping with the optimistic tone, chapters conclude with a case history of a successful individual. There are also excellent sections on organizational culture, dual-track career paths, and growth areas.



The book has its flaws: The writing is circuitous and repetitive at times and the artwork is lacking. There is also too much emphasis on entrepreneurial and independent-consulting options, considering the intended audience is primarily those interested in managing their careers within large organizations.

If you're wondering whether it might be time for a change, scanning the want ads, or worrying about your present employer's finances, spend an evening with this book. It can help.

The Computer Professional's Survival Guide
by Alan R. Simon, $24.95. McGraw-Hill, 11 West 19th St., New York, NY 10011; 800-262-4729. ISBN: 0-07-057574-6.

Circle 487 on reader service card

Quick Design Tips Inspire Good-Looking Pages

BY LORI GRUNIN

It's unfortunate, but many people may pass by the fabulous *How to Get Great Type Out of Your Computer* in the mistaken belief that they don't need to know or have nothing left to learn about type. But James Felici's book is about more than fonts; it's about efficiently producing attractive documents.

Felici, a former managing editor of *Publish* magazine, offers up 112 tips on printing, configuring your system, choosing the right fonts, creating text effects, recognizing and correcting problems with the finished pages, and using service bureaus, along with pointers on typography, layout, and workgroup publishing. The last chapter explains digital type and page-description languages and sheds light on how a computer sets type and how your printer and PC handle memory.

Though it addresses novice word processor users as well as professional typesetters, *Great Type* doesn't lack focus. It's well written, well designed, and well organized, and has often-humorous examples to illustrate the author's points. One caption reads, "This newsletter has more widows and orphans than a Dickens novel."

The few flaws in the book tend to be sins of omission. For instance, Felici devotes a large amount of space to instructions for creating a leading gauge, but never mentions that you can buy one. There are also areas that need more detail. For example, under Tip #4, "Make Sure Your Programs Get Along," he advises that you make sure your graphics programs can use the same fonts as your word processor and page composition program. Exactly *how* to do this could fill a chapter; more than a single sentence would have been appreciated.

Even if you never venture beyond the old standbys—Times Roman and Helvetica—you can still glean some useful ideas from this book. And it just might inspire you to try something new. □

How to Get Great Type Out of Your Computer
by James Felici, $22.95. North Light Books, 1507 Dana Ave., Cincinnati, OH 45207; 800-289-0963. ISBN: 0-89134-424-1

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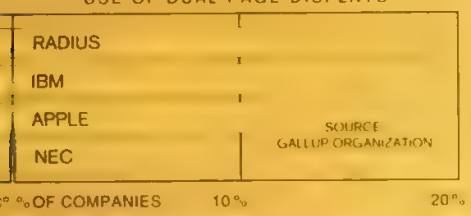
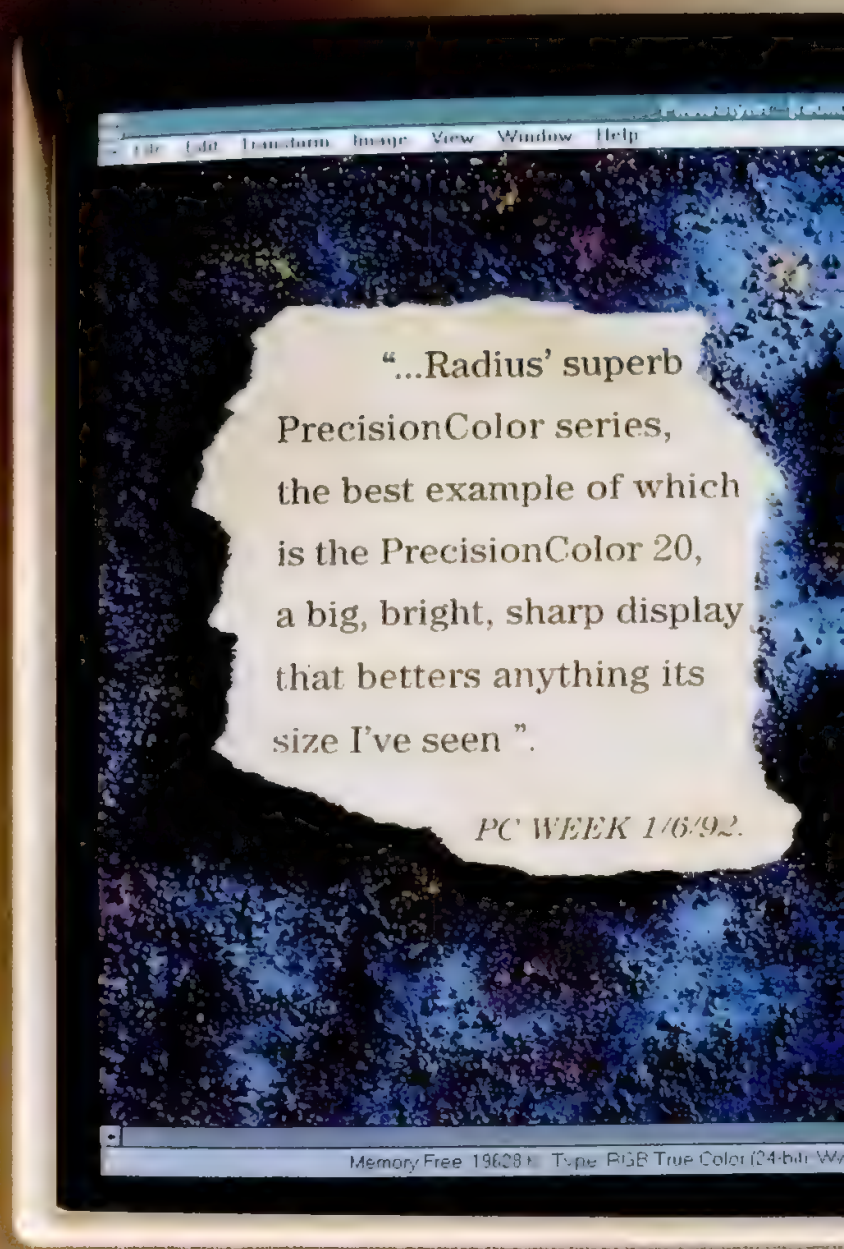


evaluations, with the most demanding standards, the PCD/20 has won hands down every time. But even more important are the productivity gains. "With the PCD/20, I can view three mainframe sessions at once, do a letter and still manage my calendar program," said one client at a major accounting firm. "I sit in front of my monitor for



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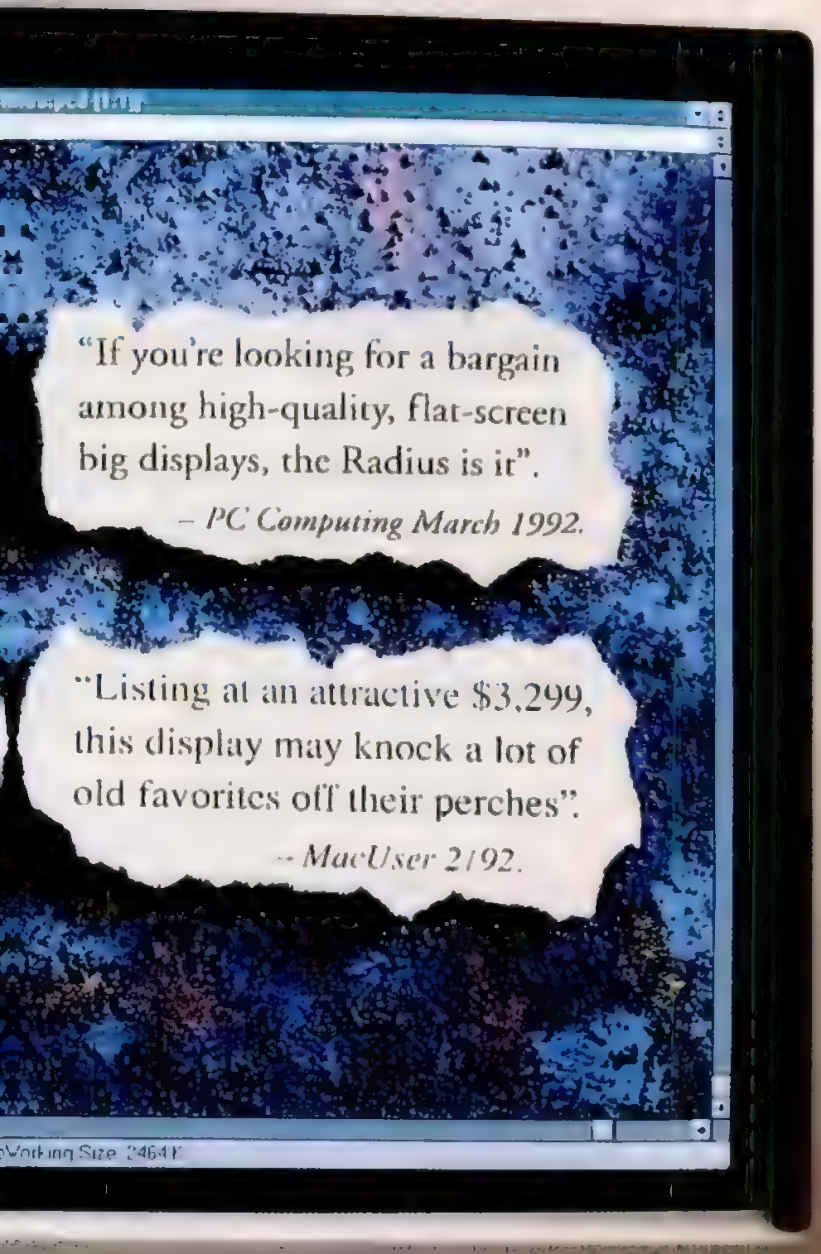

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Build Sleek Interfaces for Your Windows Programs With WCP

BY BARRY SIMON

More flexibility. More functionality. That's what you'd expect from a third-party add-in, and that's what you get with Blaise Computing's $169 Windows Control Palette (WCP), Version 1.1—a collection of custom controls, bitmap controls, and access functions you can use to build sleek user interfaces. Because they are packaged in DLLs, you can use these features from any language that can access DLLs. For this review, I used WCP with Turbo Pascal for Windows.

You can use WCP with any resource or dialog editor that supports the addition of custom controls, such as the Microsoft Windows SDK's Dialog Editor or Borland's Resource Workshop (RW). RW comes with a package similar to WCP, the Borland Windows Custom Controls (BWCC); in a few places, I'll compare the two.

Once installed, WCP expands the toolbar of your dialog editor. While there are 8 new controls, variations on them give you 14 new items. Add these to the 21 built-in controls and the 7 BWCC controls, and you have a toolbar with 42 buttons!

Creating a WCP control in a dialog editor is the same as with any control. You select a button on the toolbar, draw the associated control on the dialog box, and then double-click on a drawn control to bring up a dialog with options for that control.

Let's take a quick look at the controls:

• CPButton implements the standard Windows push-button behavior and is a bitmap control. (A *bitmap control* is a custom control that uses either its default bitmap or one you specify in the painting of the control.) As such, it requires a bitmap for each state of the button: focused but not pressed, pressed, not pressed, and disabled.

• CPStatic is for displaying text, bitmaps, and icons. Its ability to give text a raised or chiseled effect is not present in the BWCC included in Resource Workshop.

• CPRadioButton and CPCheckBox are analogous to the standard Windows controls, but they support bitmaps for their different states, such as selected or disabled. CPRadioButton has four states and CPCheckBox has six states. By having each state support a bitmap, you can "animate" the transitions between the various states.

• CPSpin provides a 3-D spin button, and CPMeter provides a gauge control to show the percentage of an operation that has been completed.

• CPCanvas allows you to display filled, 3-D rectangles on which you can place other controls. It has no Windows counterpart, but it is handy. With it, you can group controls or group separate portions of a window or dialog.

• CPToolbar is the most impressive control. It is made up of bitmaps that look like buttons and are managed by the toolbar control. Each bitmapped button has two states: selected and not selected. There are no default toolbar bitmaps; the application must provide the bitmaps to the toolbar each time it is painted on-screen. The advantage: The toolbar's appearance can change when a program runs.

CPToolbar is the only control that can't be created in a dialog editor, because it isn't exactly a control. Its behavior is more akin to that of a modeless dialog box, and it is created by a call to CPCreateToolBar within the WCP DLL. Routines are provided that then let you create and initialize CPToolbar with your choice of bitmapped buttons.

There are several advantages to creating your dialog boxes with WCP: It draws a border around the box that gives the box a 3-D appearance, and (unlike BWCC) it lets you choose the brush for the background or use the default. In addition, it includes an optional "fast paint" style for CPStatic and CPCanvas controls that lets the dialog box window function control their painting; this enhances display performance. BWCC dialogs have a similar feature, but they take over the drawing of the custom controls without giving you a choice.

As an extension to OWL (Object Windows Library), WCP's custom controls have one or more corresponding OWL objects in this hierarchy. For example, the TCPSpinList object combines a spin control, a text display that's linked to the spin control, and a canvas that goes behind the other two. In one style, the text displays the current number set by the spin control; in another, it displays one of a set of text strings that you specify.

My one criticism is of WCP's documentation: Its tutorial is too limited and its examples are trivial. But this is a relatively minor complaint. Its flexibility, functionality, and support for a variety of different C compilers as well as other languages make Windows Control Palette something you should add to your library. □

Windows Control Palette, Version 1.1
List Price: *$169.* Requires: *Windows 3.x and at least one of the following: Turbo Pascal for Windows, Version 1.0; Borland C++, Version 2.0 or later; Microsoft C, Version 5.0 or later; or Visual Basic.*
Blaise Computing, 819 Bancroft Way, Berkeley, CA 94710; 510-540-5441.
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Michael J. Miller

The Secrets Behind Windows

Who knows what evil lurks in the hearts of men? That was the question posed in the old radio show "The Shadow." Today the question is: Who knows what secrets lurk in the hearts of Windows programmers? In its worst form, this question was raised by the *New York Post,* which devoted its April 20, 1992, front page to the "Program of Hate"—Microsoft Windows 3.1. If you choose the Wingdings TrueType font in Windows and type "NYC," you'll see a poison symbol, a Star of David, and a thumbs-up symbol. Some people interpreted this as an anti-Semitic message, and New York's most zealous tabloid seemed to agree. In case you weren't in New York that day, let me just say you'd be amazed at the intensity of the overreaction.

There are more than a few flaws in the theory reported by the media. First of all, Wingdings is not designed to be typed in as usual. The font is a collection of symbols you can insert in your documents as simple graphic elements. Far from a new idea, it follows in the grand tradition of Zapf Dingbats and other symbol fonts. I don't believe that symbol fonts mean anything, and Microsoft strongly denies that there are any hidden messages in Windows 3.1. More than anything, the incident reflected the gap between the growing universality of computer use and computer illiteracy in the mass media.

More to the point, people seem to misunderstand the simple statistics behind the issue. It's very easy to read meanings into combinations of symbols. That doesn't mean such meanings are there. If symbols are assigned—in no particular order—to 220 possible keystroke assignments, you can be certain that many common combinations of letters will map to combinations of symbols that someone, somewhere, will consider meaningful. This is particularly true when you include symbols that many people will find useful, such as those representing Christianity, Judaism, and Islam.

If you're curious, go to your Windows word processor, change the font to Wingdings, and type the whole character set. It all looks pretty logical—you won't notice any obvious malicious pattern. I'm more inclined to believe that anything you read into the pattern of symbols probably says more about you than about the font. After all, you can write a hate letter using any word processor.

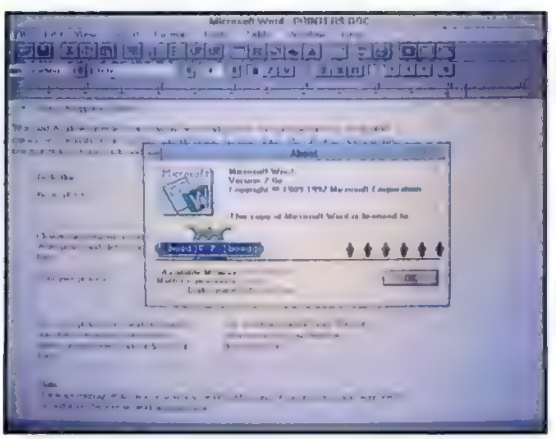
COLUMNIST PHOTOGRAPHS BY PETER GREGOIRE

SEE FOR YOURSELF

The Wingdings controversy was blown out of proportion, but that doesn't mean that Windows isn't hiding something. It is.

Try this: Go into the Program Manager in Windows 3.1 and open the About box under the Help menu. On the screen, you will see the Windows flag. With the Ctrl and Shift keys held down, double-click on the green section of the flag, then click on OK to close the box.

The first time you do this nothing happens. Try it again, but don't click on OK right away. This time, a small Windows flag will appear and start to wave; now click on OK to close. The third time you go through the steps, a little box will pop up with an image of a person beside a list of the members of the Windows development team. The list of names will scroll by. (The names take a while to parade by;



They could be hiding out in your computer, too. Secret screens: What are they and where do they come from?

it was a big team. Just click on OK to escape.)

Go through this process of opening and double-clicking on the flag three times. For each color of the flag you click on, you'll see a different person. The four images are of Bill Gates, Microsoft vice president Brad Silverberg (who headed the Windows team), Microsoft executive vice president Steve Ballmer, and the Windows 3.1 team mascot, a teddy bear. (Don't ask.)

Hidden messages are also lurking beneath many Windows applications. Open a document in Word for Windows 2.0, go to the Record Macro command under the Tools menu, and create a new macro called SPIFF. Go back to Tools and hit Stop Recorder, then Macro. Select SPIFF from the list of macro names and click on Edit. Delete the Sub Main and End Sub commands that Word automatically puts in. Close and save the blank macro, then go to the program's About box and click on the Word icon.

You'll see six little men run out, followed by a WordPerfect monster—Word's biggest competitor. The little men start to panic, then squash the monster using the Word icon. They all cheer, and the About box changes to an elaborate scrolling list of the Word for Windows team. It's a little belligerent, but that's Microsoft's style.

If you use Lotus's Ami Pro 2.0 for Windows, try this. Go to the About box under the Help menu and hold down the Shift, Ctrl, and Alt keys. Press F7, then type the letters *S, P, A, M* followed by the last number in the Available Memory display and the third from the last number in that display. Then release the Shift, Ctrl, and Alt keys.

Tiny photo images of the Ami Pro developers—along with their names—invade the entire screen and start to float around. Click on the faces one by one and they'll disappear. One face, however, won't disappear but turns into T. King (an Elvis look-alike). The unofficial explanation is that you can't kill the King because he's already dead. It's fun, and you can get out of it just by hitting the Esc key.

PC MAGAZINE CONTEST

Those are just three of the many secret screens that have found a life inside Windows programs. If you have one to share, send me the instructions. *PC Magazine* T-shirts go to those who submit the best secret screens. I'll share the best of the bunch in an upcoming column.

Why do we see these secret screens in so many products? Don't the programmers have anything better to do with their time? The answer is that the screens themselves may be secret, but the message isn't. For most great software developers, creating a program isn't a job, it's a way of life. As a result, they want their names—or their faces—to be part of the program. Not in the documentation, but in the code itself.

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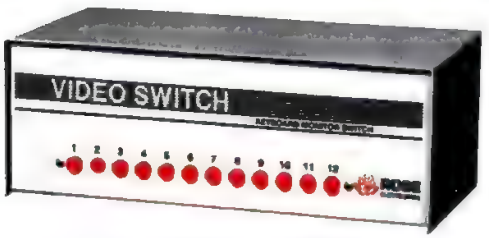

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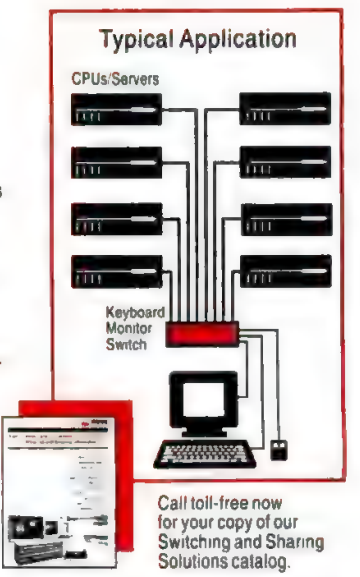

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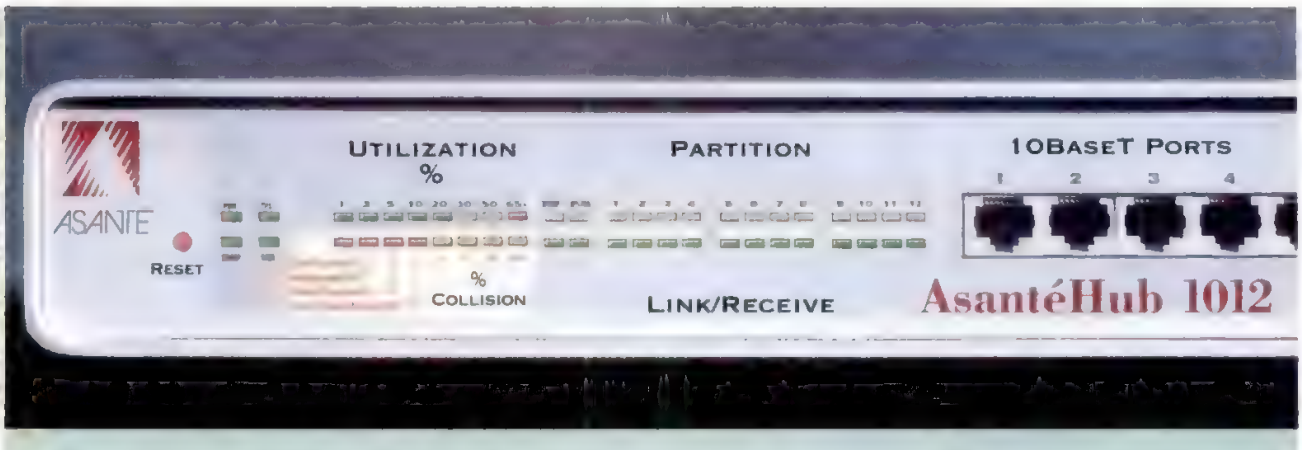

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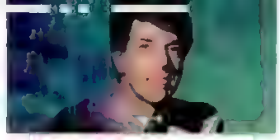

Bill Machrone

Honest Abe and the 486

Abe Lincoln was addressing a crowd during the Civil War. A person in the audience asked Lincoln why he didn't just declare the slaves to be free and be done with it. In reply, Abe asked the crowd, "If I told you that a lamb's tail was a leg, how many legs would a lamb have?"

"Five," came the answer.

"No, four," said Abe. "Calling a tail a leg doesn't make it one."

Ladies and gentlemen, I stand before you today to tell you that the Cyrix 486SLC is a lamb's tail. In calling this thing a 486, they've devalued and distorted the true meaning and understanding of what a 486 chip is and what it does. This business is complex enough without vendors attempting to take a free ride on the successful marketing and technical efforts of others.

The Cyrix chip (I hereby cease to call it a 486) executes the 386 instruction set, and it has a 1K on-board cache and 16-bit I/O. If you think this sounds like a 386SX with a cache, you're right. In fact, the Cyrix chip is pin-compatible with the 386SX. Somehow, though, the marketing geniuses at Cyrix decided that the cache makes it a 486. It also has a hardware multiplier, which, while interesting, is really a far cry from the full floating-point math capabilities of an Intel 80486DX.

In order to understand exactly why the Cyrix chip is not a 486 chip, we first have to understand exactly what a 486 is; we must get to the essence of the chip, its 486-ness. As we'll see, this isn't easy.

Intel billed the first 486 chip as a combination of the 386 and the 387, with the math coprocessor right on the same chip. It had an on-board 8K cache, and many of the instructions executed faster. It also communicated with the memory subsystem at the chip's clock rate, rather than two times the clock rate, which was how the 286 and 386 did it.

Intel was the first to monkey with the definition when it introduced the 486SX. Before that, there was only a single 486. Then came the 486DX and SX designations. The SX, you'll recall, was identical to the 486 in every respect except that the math coprocessor had been disabled. As I've opined in the past, the SX designation was an error on Intel's part. Why? Because in the 386SX, it denoted that the chip had 16-bit I/O. Intel, however, decided that SX connoted "inexpensive," and used the designation to position the 486SX against the AMD 386. As a result, the floating-point unit (the coprocessor) ceased to be a distinguishing element of the 486.

What about the cache? IBM then introduced a 386SX chip with an on-board cache. (IBM is a licensee of Intel's chip designs and can manufacture its own Intel-based microprocessors.) IBM called it the 386SLC. Clearly, IBM didn't think that an on-board cache could make the chip a 486. Now that the Cyrix chip is on the market, I doubt that anyone at IBM will be slapping their foreheads and saying, "Dang, we could have called it a 486!"

ILLUSTRATION BY TIMOTHY CARROLL

A far cry from a true 486, the Cyrix 486SLC by any other name would be a blessing.

The Cyrix chip is pin-compatible with an Intel 386SX. Don't get the clever idea, though, that you could just pop out your 386SX chip, slide in one of these babies, and gain the performance benefits of the on-board cache and the minimalist floating-point hardware multiplier. Forget it. Sad

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Bill Machrone

to say, the Cyrix chip, for all its posturing, isn't even a very good 386SX clone. Although it's pin-compatible with the 386SX, the timing signals are sufficiently different that not only would you need a whole new BIOS but the motherboard would probably have to be modified as well.

Who should buy these chips? Probably some low-end vendors who will sell them through price clubs or in bottom-of-the-line direct-market machines. Some buyers are less critical than others when it comes to reading the fine print.

You'll also see the 3-volt version of the Cyrix chip in some notebook and pen computers, where the small physical size will be a benefit. Timing and BIOS compatibilities notwithstanding, the Cyrix chip performs well. People who buy machines based on it will get snappy performance at a reasonable price. But they won't get true 32-bit computing. And they won't get a full 8K cache. They'll get a hardware multiplier, but not a full floating-point coprocessor, to fuel their CAD programs and spreadsheets.

ELUSIVE ESSENCE OF THE 486

The true essence of 486-ness remains elusive. Clearly the 386 instruction set is the foundation. A full 8K cache is important. A 32-bit data path is essential, especially when you consider the coming wave of local-bus implementations of video, disk, and networking. Since Intel can take or leave the math coprocessor, we can, too. It's nice to have, but not essential. Cyrix's reason for having the hardware multiplier—rapid calculations for graphics—is nice, but most of the new VGA chips do the same thing internally without any load on the processor.

Don't underestimate the importance of the 486's other distinguishing trait: the memory bus that operates at the same rate as the clock. Intel's memory architecture makes a lot more bus cycles available for other devices. This is just as critical as a 32-bit data path for local-bus implementations.

I suppose the guys at Cyrix can always get a job selling "My Other Car Is a Rolls-Royce" license-plate frames. □

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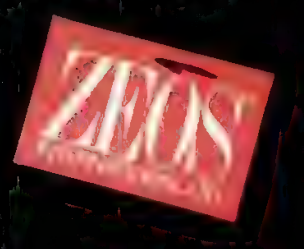

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John C. Dvorak

My Wife Thinks I'm Nuts

I was reluctant to move to OS/2 2.0, but now I can't imagine using anything else. If you have the horses, you're crazy not to try it, folks, no matter what they say. It takes 55 minutes to install, and if your hardware can handle it, the software is rock solid, just like all the OS/2 nutballs say it is. My earlier reluctance stemmed from my observation that the OS/2 promoters acted like the crackpot Amiga users who think that all mankind is crazy because the whole world doesn't use the Amiga. This is a different crowd from the Mac fanatics, who are just plain arrogant. But at least the Mac fanatics don't whine so damn much, as the Amiga (and OS/2) users do. It's not particularly fun to tell these guys that they were right. They still whine at you: "Why don't other columnists say so, too?"

So anyway, after figuring out that I really did need a chip-cooling fan (OS/2 overheated a 50-MHz 486 system and it died), I installed OS/2 on a new Club America machine with 16MB of main memory and a 450MB hard disk. The installation process wasn't as crappy as I was led to believe.

What's fascinating about OS/2 is its ability to run DOS programs up to three times as fast as DOS itself. Most of this speed increase is credited to the high-speed file system. It's incredibly quick considering the huge size of the code. More impressive are the seamless, simultaneous DOS application sessions. I can now download files at 14.4 Kbps using vanilla Telix in the background while keeping XTree Pro Gold and a couple of word processing documents in memory (and working) all at once. It's amazing how stable it is and how solid it feels.

That's the good news. The bad news is that the Microsoft propaganda machine is working overtime to keep this OS out of the hands of the users. The things I've been told by the Microsoft people simply don't wash. This version of OS/2 is one nice piece of code. It runs Windows 3.0 better than Windows 3.0 itself and runs DOS better than DOS, for sure. And you don't need to spend a fortune on DOS extenders and memory managers. They're all built in as they should be.

All it doesn't do is run Windows 3.1, but so what? Version 3.1 is a bug-fix and performance upgrade with compatibility problems. With a fast 486 you get the performance increase anyway. The Windows code in OS/2 is from Microsoft, so it's compatible.

Having said all that, I can outline the downside. It requires the following minimum configuration (this is my list, not IBM's): a 33- or 40-MHz 386, 8 to 16MB of RAM, and an empty 100MB hard disk. And it doesn't like Tseng-based video cards, from what I can tell. It's a complicated system that doesn't want to be turned off but has to be "shut down" with a software command. The IRQs are a little different, and there's a ludicrous number of custom options for DOS sessions.

Plenty of people don't care about background downloading or keeping 100 programs in memory at once. There were plenty of people in 1982 who stuck with CP/M and the Z-80, too.

My advice: If you have the hardware, you'd be nuts not to try OS/2. Unfortunately, I've become so enamored that my wife thinks I'm nuts; she claims there must be some hypnotic message blinking on the screen. Maybe she's right. Too late now!

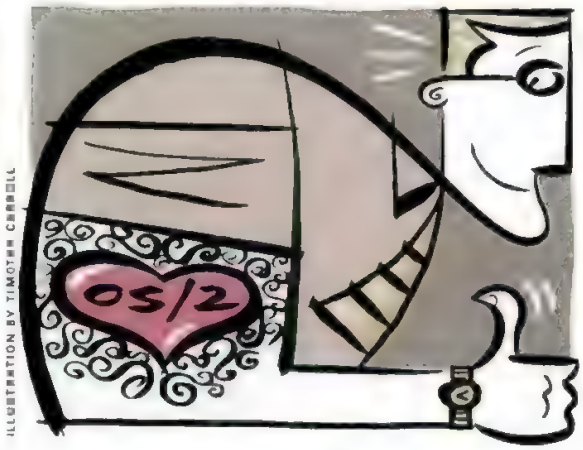

ILLUSTRATION BY TIMOTHY CARROLL

Drop any preconceived notions about OS/2 and just install it. If you've got the right machine, it's rock solid.

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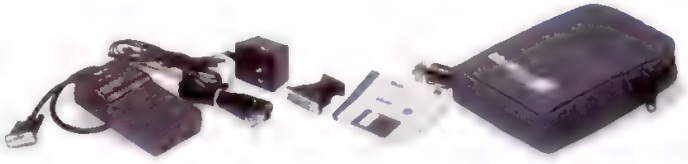

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John C. Dvorak

Inside Track

Look for **Intel** to add functionality to its newest line of micro-processors. Adding a cache and support circuitry to the 386 gave us the 486. Now the company is talking about **adding VGA or XGA** circuitry right **onto the microprocessor.** This is at the urging of Microsoft, to allay complaints about Windows **video bottlenecks** and help standardize the video capabilities of today's clone. Adding video to the microprocessor will make the display blazingly fast. The idea is a good one, except that when a new video standard comes out, you'll have to buy a new computer. The irony is that improvements in video standards have coincided with the point where you *should* buy a new computer.

486/50 systems are selling like hotcakes, and a shortage of the chip is upon us. Expect prices for the machine to stabilize, then slide again at the beginning of 1993.

I suspect that before the battle of the operating systems is over, **Microsoft** will have persuaded Intel to produce a 486 (or whatever) that has Windows on the chip itself in microcode. Why not?

Power? Who Needs It Dept.: I was amused by a stock comment made by one of those official "industry analyst" types. The guy said that the newest 486 chips are really not for the average user, but for **specialized high-end workstations.** Ever since the announcement of the 286, analysts have said that the newest chip was for high-end workstations. It's a good thing for the Intel accountants that users don't feel this way. I've talked to a lot of cloners, and they're reporting **huge sales** for 486/50 PCs. It's even the top-selling machine for quite a few vendors. A **shortage** of the chip is upon us. It will continue through the end of the year and stabilize prices for the machine.

Expect to see the **prices** begin to **slide** at the beginning of 1993.

If you like to watch these price trends, there's a new **newsletter** called *The PC Street Price Index.* It's 25 pages of price data **reflecting street prices** of everything from 386SX machines to AskSAM software. Not cheap at $195, the newsletter is a must-have for large corporations and for vendors who want to know the *real* price of their competitors' products. Call Metro Computing of Cherry Hill, New Jersey at 609-784-8866.

Contradictions Dept.: While OS/2 and Windows 3.1 duke it out in the market and in the minds of users, **DOS is hardly dead.** Or is it? The programming community says Microsoft is going to **bail out of DOS** in the next 24 months and move everyone into Windows NT. At least two groups of programmers who claim "to know for sure" what Microsoft is doing say this will happen sooner than people think. Unfortunately, it doesn't make much sense, especially if Microsoft insists on **selling Windows NT for $500 or so!**

In fact, **Microsoft is readying MS-DOS 6.0** and early beta versions should be in testers' hands within the next few months. It's expected to **include Stacker,** the popular disk compression program that will compete with SuperStor, which is bundled with DR DOS. The OS/2 crowd has been **demanding** some sort of Stacker support for HPFS (High Performance File System), but with the company doing a lucrative bundling deal with Microsoft, users may find the Stacker support for OS/2 slow in coming.

Microsoft's main concern, though, is security. Not security for users, but security for profits. **Counterfeiting** of MS-DOS is affecting the company's bottom line, say observers.

With the release of MS-DOS 5.0, the company tried to **minimize abuse** by using an "uncopyable" hologram on the DOS 5 box. Immediately, a factory in the People's Republic of China **copied the hologram** and sold copies to counterfeiters in neighboring Taiwan and elsewhere. Microsoft is prepared to take drastic action, including a serial number scheme in DOS 6.0.

While on the Subject of Security Dept.: An interesting company in the hick town of Troutdale, Oregon, has developed a solution to identifying **stolen computers.** Micro Law Software (503-666-6599) has a screwball program that puts a "signature" on a user's hard disk. The company admitted that a super hacker could defeat the Micro ID, but said that few thieves will even know the stolen computers are marked for identification. Anyway, the company works mostly with **law enforcement agencies** and large corporations. I spent a long time talking to these guys and they may have something here. Give them a call. □

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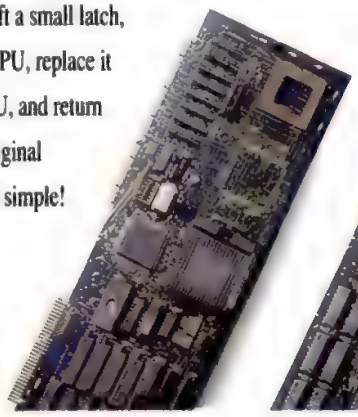

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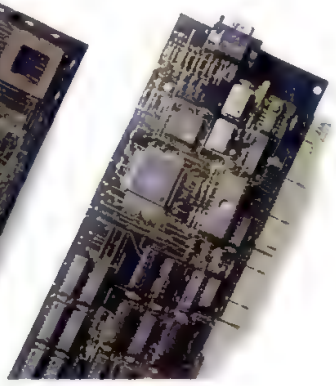

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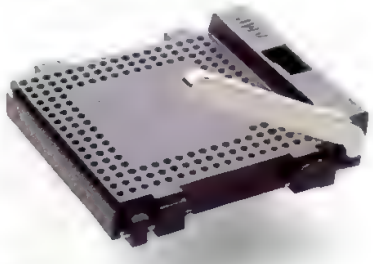

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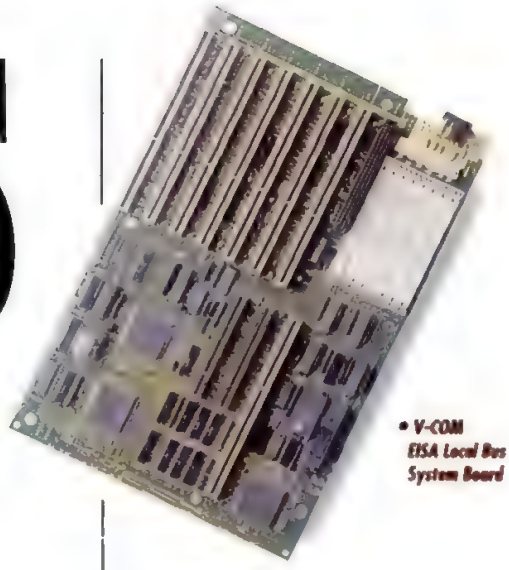

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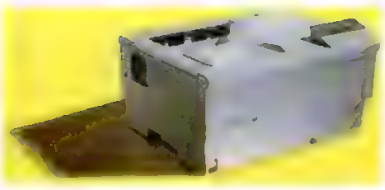

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Jim Seymour

The Uninstall Crunch

It may not be the biggest problem PC users face, but surely it's one of the most infuriating things we have to deal with. I'm talking about the difficulty of uninstalling. In the simpler days of DOS—especially if you installed each application in a separate directory—deleting a program you no longer wanted was easy: Change to the right directory and erase all the files.

But with Windows came insidious, piggy programs that scatter files all over your disk, litter entries throughout your WIN.INI and SYSTEM.INI files, and generally make themselves almost impossible to remove.

The problem exists for all PC users, but it's especially acute for some. I may put a hundred new programs on my PC every year. Many stay on the disk just a few days or weeks. I look at them, use them, then go on to other work. It's imperative to get unused programs off the disk.

Imperative or not, it's often damned difficult.

And it turns out that a lot of other people have the same problem.

A typical corporate PC coordinator, for example, evaluates dozens of new programs over the course of a year. Sure, hard disks are getting bigger, but all disks fill up too soon. Indeed, PC managers complain loudly about the difficulty of uninstalling many new programs.

They're not alone. Consultants may install evaluation copies of six or seven similar programs on their machines while examining alternatives and making recommendations to clients with specific problems. How are they supposed to get tenacious, ill-behaved apps off their disks?

In fact, almost every active PC user faces this problem at some point. With today's changes—moving to networkable or graphical-user-interface versions of old applications, and often, to altogether new GUI apps—everyone who uses more than one or two programs has to get the old ones off the PC's disk.

Users' experience with Norton Desktop for Windows is a good example. Desktop 1.0 added much of what Microsoft left out of Windows 3.0. It became deservedly popular. But many PC users, me included, came to grief over how long Norton Desktop took to load. If your PC has many fonts, Norton can take several minutes to deliver a working desktop—with the inevitable result that many of us who were great boosters of the program decided we'd have to forego its slick file management, drag-and-drop, and other features for the sake of performance. We decided to take Norton Desktop off our PCs.

Woe to us.

Scraping Norton off your machine (including removing its lines in the WIN.INI and SYSTEM.INI files, or at least enough of them to get it out of your way) takes forever. I probably still have Norton 1.0 references in there, and some Norton files scattered around the disk, too.

ILLUSTRATION BY TIMOTHY CARROLL

Installing Windows apps is easy. It's getting rid of them that's nearly impossible.

Norton was driving corporate evaluators—many of whom were fans of the program—crazy.

Symantec, the publisher of Norton Desktop, caught on on both counts. Not only is version 2.0 faster—not fast, but faster—but the program can be uninstalled fairly easily.

With Windows apps, this task is more complex

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CIRCLE 037 ON READER SERVICE CARD

Jim Seymour

than it first appears. The problem lies primarily in additions to those messy Windows startup files, WIN.INI and SYSTEM.INI. Just making .BAK copies of those two files at installation time is not enough, even if the backups carry a filename extension such as .NDW to make them relatively immune to overwriting when you install programs later on. Indeed, it's those later installations that will kill you.

Say I put Seymour Desktop for Windows on my machine. SDW, like all well-mannered programs, makes backups of the .INIs as I install them. Over the next three weeks, I install six more Windows applications. Each application, of course, adds lines to my Windows .INI files.

Then I decide to uninstall Seymour Desktop for Windows.

The manual assures me it can restore things to just the way they were. Sure enough, the program's smart uninstall routine erases all of the SDW program files, .DLLs, and so forth. Uninstall also renames WIN.SEY and SYSTEM.SEY—the preinstall backups of my .INI files—WIN.INI and SYSTEM.INI. And in the process, it wipes out the expanded versions of those files created by the programs that I installed after SDW.

That's an improvement?

I've been working with beta versions of two interesting new programs from tiny Maximized Software. One, Uninstaller, ferrets out not just program and help files, but also all the other junk programs leave behind, from icons to WIN.INI associations, document extensions, and even OLE objects. And Quick WIN.INI Cleaner allows easy, informed manual clean-up of your WIN.INI file.

Uninstaller and Quick Cleaner are not quite ready for prime time yet, but they're close. I think that they're going to be a godsend for many of us. If you're interested, call Maximized Software at 310-578-7657.

As much as I like these two utilities, I regret the need for them. Software developers should include thorough uninstall utilities with applications. Otherwise, we'll continue to have to put up with this stupid clutter on our PCs. □

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William F. Zachmann

Pen-Based Systems? Forget It!

Despite growing hype, pen-based computers will have no more impact on most PC users than the quill pen. That was one of my 13 annual predictions for 1991, and I was right. Halfway through 1992, I'm still not sold.

Last year, I left the door open for a more positive view later on. I thought that as the technology matured, pen-based systems might eventually become important options. Besides, many very nice people had bet their futures on pen-based systems, and I wanted to give them the benefit of the doubt.

I'd like to be able to say now, more than a year later, that I'm convinced pen-based computing is ready to take off. I'd like to be able to say I now think pen-based computing is on the road to success. Unfortunately, I cannot—because it isn't.

Pen-based computing isn't going to be the next big thing in the industry. It isn't even going to be the next little thing. It is going to be a big bust relative to the expectations it raised.

Like the Hewlett-Packard touch screen of the early 1980s, the idea of pen-based computing is much more appealing than the reality. It will be, at best, no more than a relatively minor niche product. At worst, it will be a total flop.

Contrary to what lots of folks assume, writing by hand is an absolutely terrible way to get text into a computer. Once heralded as the salvation for those who can't type, the best handwriting recognition falls pathetically short even of untutored hunt-and-peck typing on a keyboard for text input.

In fact, none of the present or proposed systems come close to recognizing ordinary cursive handwriting. Any system that's reasonably affordable requires laboriously printed manuscript letters. Even then, the results leave a lot to be desired. None of the wannabe-notebook-size pen computers do a very good job of getting it right for anything but the most meticulous handprinting (as opposed to handwriting).

Advocates of pen-based systems, of course, say that the machines' real strength does not lie in handwriting recognition anyway. That's for sure! However, the systems' supposed strong suit—the use of pen gestures to control the system—isn't much better. You need to have sunk a few million bucks into a pen-based computing startup to believe otherwise.

Except for highly structured applications, most real computing requires some sort of text or numerical input. Gestures alone are rarely sufficient.

What's more, using gestures for control is a lot more cumbersome than its explanation might lead one to expect. Besides, pen-based systems seem to have as much trouble recognizing the gestures as they do with characters. Just try it for a while and you'll see what I mean.

Finally, most people can use the processor power, RAM, and disk storage required for even a marginally adequate pen computer to provide additional capacity for meat-and-potatoes uses. For most, the money required for a so-so pen-based system is better spent on a first-rate portable with a keyboard.

If you have nothing better to do, by all means explore pen computing. But if you have real work to do, you'll probably be better off ignoring it in favor of more prosaic technology that really does the job. □

ILLUSTRATION BY TIMOTHY CARROLL

Thumbs down to pen computers. Even the best have trouble recognizing gestures—let alone lousy scrawl.

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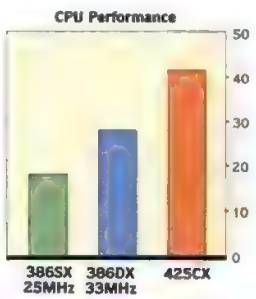

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386 AND 486 NOTEBOOKS

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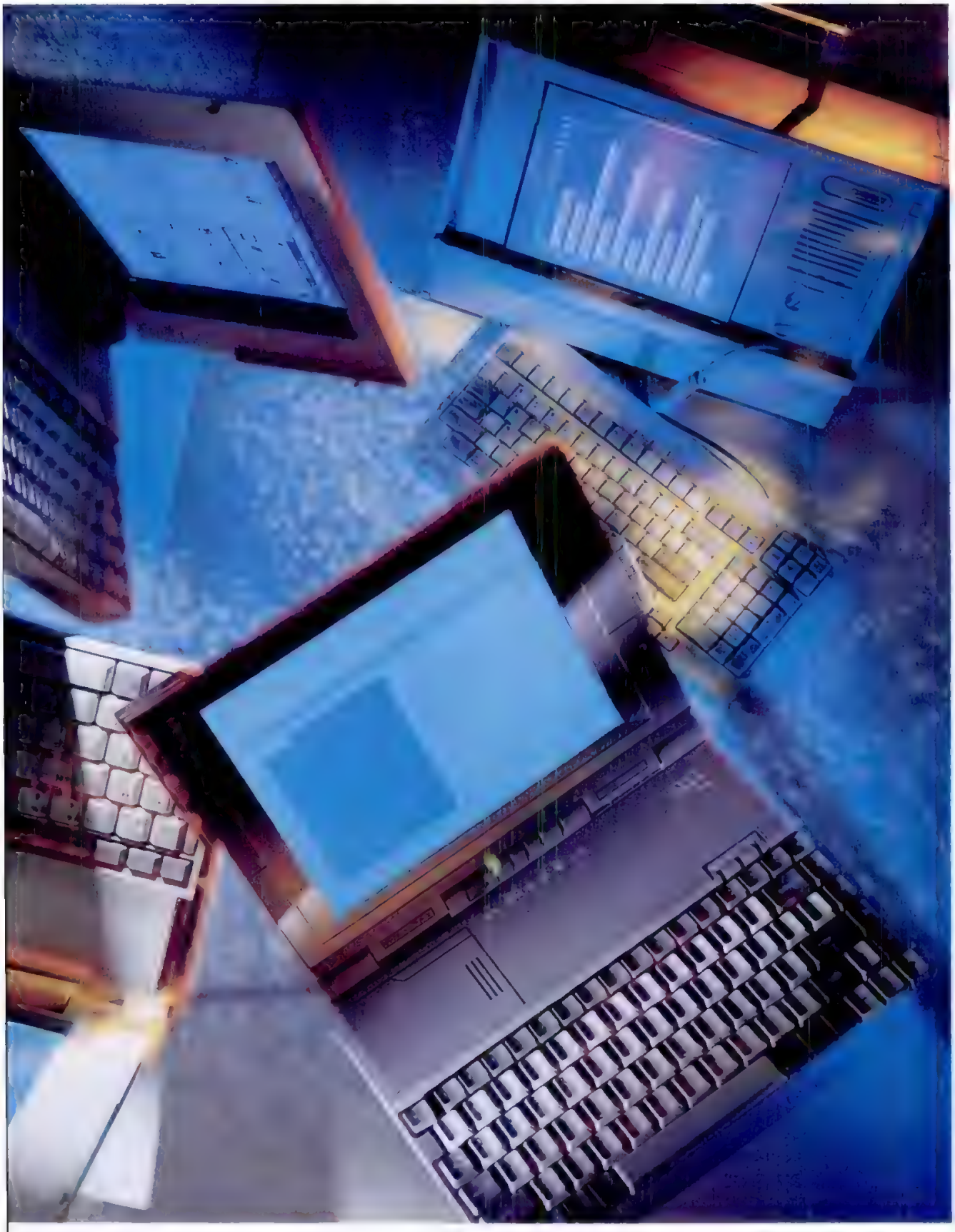
With fast processors, 80MB hard disks, 10-inch displays, and modems, today's notebook PCs can do it all, anywhere. PC Labs tests 80 systems in our biggest portables story ever.

by Bill Howard

The life cycle of a portable computer can be measured in months. From new-product introduction to product maturity to discounted dealer closeout, less than a year elapses. But your laptop will be around for several years after that. That means it is important to choose a system that won't seem obsolete or underpowered 18 months from now.

In this issue of *PC Magazine*, we offer a snapshot of the state of the art in portable computing as of mid-1992, with hands-on reviews of 80 battery-powered monochrome notebooks and battery- or AC-powered color portable PCs. Virtually none of the 80 machines were on the market as of our last review of notebook portables (April 14, 1992), and we suspect many of them will be superseded by the time we review portables again at year's end.



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In this issue, which is devoted to DOS on the road, we also review portable modems and portable printers. In addition, we've prepared a foldout road warrior's summary of information you're likely to need when away from the office: phone numbers of major electronic mail services, log-on information, and voltage and electric plug types for most major countries. We've also summarized the service and reliability findings for portable computers from our issue of May 26, 1992, which reflects readers' opinions of who is providing the best machines with the best service.

WHY PAY MORE?

Ever since the first Compaq portable arrived in 1982 and the first Toshiba laptop came out in 1986, it has been a truism that you pay extra—perhaps as much as 50 percent extra compared with the price of a desktop system—for the convenience of portability. Recently, however, buyers have been showing some resistance to paying a significant premium for systems with less performance, smaller hard disks, compromised keyboards, limited expandability, and noncolor displays. That consumer resistance should lead to a modest decrease in the price differential in the coming months.

The credit for this good news goes to some of the mail-order vendors and the discount warehouse stores. Companies such as Compudyne Products, Dell Computer Corp., and Gateway 2000 have put the pressure on traditional laptop leaders such as Compaq and Toshiba. A year or two ago, your choice in laptops often came down to well-built, high-priced systems from famous names such as NEC and Zenith Data Systems or clunky, bulky off-name brands held together with spit and baling wire. Now there is parity (in available options as well as quality and price) among a greater number of vendors and better choices for buyers.

Parity doesn't extend all the way to the lowest reaches of the portable market, as proved by some of the 80 portables covered here. During the fact-checking phase of this issue, *PC Magazine* researchers ran into vendors who didn't know whose video chips were in their systems, the manufacturer's model numbers on their hard disks, or the amp-hour ratings of their batteries. Read the reviews and the Summary of Features carefully to see which vendors are directly involved in creating and quality testing systems to their own specifications, and who is buying ready-to-go boxes assembled halfway around the world.

While the portables market remains robust—growing at an estimated 35 percent annually, compared with 10 percent for desktop PCs—the competition proved too much for some vendors. Panasonic and Philips have recently withdrawn from this market. According to Computer Intelligence, the vendors of notebook computers with at least a 5 percent market share worldwide (based on the value of shipments) are Compaq, NEC, Sharp, Tandy, and Toshiba. Leaders in the now-fading market for bulkier laptop computers are Epson, IBM, NEC, Sharp, Toshiba, and Zenith Data Systems.

REVIEW CRITERIA

In order to focus on the products interesting to business users, PC Magazine Labs set the following requirements for inclusion in this issue: Each computer had to be a keyboard-operated notebook PC with at least a 20-MHz 386SX or 386SL processor (or an AMD equivalent), battery-powered, and weighing no more than 8 pounds with its battery installed. We omitted 16-MHz 386SX and 386SL systems because no major vendor has recently introduced one, with the exception of a well-intentioned but misguided offering from IBM. For color systems, we removed the battery-powered and maximum-weight requirements. Units had to be shipping as of midspring.

We acquired 65 battery-powered monochrome notebook systems, which are reviewed in the section immediately following this introduction. We also reviewed 12 color portables (5 battery-powered), a monochrome active-matrix twin brother of the NEC ProSpeed 486SX/C, and a hybrid monochrome/color system for use with an overhead projector. (See "Laptops A-Go-Go: Color Hits the

Road" for more information). The new Apple PowerBook 170 is covered in the sidebar "PowerBook 170: Apple's Power Portable." (This portable can run DOS software, albeit at a leisurely pace, and provides two features Intel-based portables don't have: a useful trackball and a high-contrast 1-bit display that is either on or off, with no gray shades.) This raises our total number of tested systems to 80 notebook and color portable PCs.

Several dozen systems were announced but unavailable for review by our testing deadline. These include systems from vendors who weren't part of the first wave of SL shipments, and the first of the 3- to 4-pound subnotebooks unveiled in late spring. We intend to review those systems later this year; in addition, *PC Magazine*'s First Looks section will review the most significant systems as they ship. Among the major products that were announced but were not shipping in time for review are

- the Compaq Contura 3/20 and Contura 3/25, two low-price 20- and 25-MHz 386SL systems, respectively; the Compaq LTE Lite/25c, an active-matrix color variant of the Compaq Lite/25 reviewed here; and the monochrome active-matrix twin of the Compaq Portable 486C;
- the Librex T386SX, based on the 20-MHz Cyrix 486SLC;
- the PC Brand 486/SLC, based on the 25-MHz Cyrix 486SLC;
- the Samsung NoteMaster 386S/25, based on the 25-MHz Am386SXL;
- the Texas Instruments TM4000 WinSX/16, a 16-MHz 486SX; the TM4000 WinSX/25, a 25-MHz 486SX; and the TM4000 WinDX/25, a 25-MHz 486DX. TI-built Gateway systems reviewed in this issue are similar to but not the same as the new TI notebooks;
- the Twinhead Slimnote 486DX/33, a 33-MHz 486DX;
- and the Zenith Data Systems Z-Note 325L, a 25-MHz 386SL.

PERFORMANCE: NEW BENCHMARKS

The reviewed systems cover nearly a dozen CPU types, from 486DX/50s (such as the Dolch P.A.C. 486-50E, a 21-pound color system) to 20-MHz Intel SLs and SXs to 20-MHz AmSXLs. CPU performance was generally no different from what PC Labs has found in the past from desktop PCs using the same CPUs. AMD CPUs powered 13 of the systems. In this review, there were no laptop or notebook systems based on the Cyrix 486SLC chips, which despite the name are more like 386 than 486 chips (see Bill Machrone's Viewpoints column for details).

Among the 65 battery-powered monochrome notebooks, the range of CPU performance was 5 to 1 from fastest (the Tandy 4860 HD) to slowest (Intelec's Halikan 386SX/20), based on PC Labs' processor test. (Among all portables reviewed, including the color luggables, the performance range expanded to 8 to 1.) If you're running Windows-based applications, you will appreciate the extra horsepower a 486 CPU provides.

You'll also want fast video, and it was here that many of the battery-powered notebooks fell. Only five monochrome systems generated Graphics Winmark scores of more than 2 million: the Compudyne 486DX/33, Gateway Nomad 425DXL, Tandy 4860 HD, and Toshiba T4400SX in its LCD and gas-plasma versions. By way of comparison, a low-cost frame-buffer video adapter based on the Tseng 4000 chip set running on a 386SX/20 desktop PC might produce a Winmark score of 1 million, or 2 million on a 486/33. But accelerator-based cards such as the ATI Ultra or those based on the S3 chip set that are the right choice for desktop performance produce Winmark scores in the range of 4 to 8 million (see "The Perfect PC," *PC Magazine*, July 1992 for more information), and PC Labs has tested systems due later this year that produce Winmark scores of 15 to 20 million. (Among the color portables we reviewed, nearly half the products managed

HIGHLIGHTS

Monochrome Notebook PCs

THE IDEAL NOTEBOOK system has a 25-MHz 386SL or 486 CPU, a 120MB hard disk, weighs less than 7 pounds with its battery and transformer, and runs for at least 3 hours. The Toshiba T2200SX, Toshiba T3300SL, and the three Texas Instruments–built Gateway Nomad systems come closest to this ideal.

CPU PERFORMANCE spans a 5-to-1 range between the fastest (the Tandy 4860 HD) and slowest of the 64 monochrome battery-powered notebook systems. If you plan to run Windows, look for a system that performed in the top third.

FOR THE 64 monochrome systems, the average battery life was 2.5 hours; 20 systems ran for at least 3 hours. The Gateway Nomad 425DXL and NCR Safari NSX/20 each topped 4 hours. Systems with AMD CPUs had slightly better battery lives than Intel SL–based systems.

AS WINDOWS workstations, these systems come up short on graphical power. Only five units generated Graphics Winmark scores of more than 2 million (fast desktop PCs produce 4 to 8 million). Only a handful have built-in pointing devices.

NOTEBOOKS USING PCMCIA- or JEIDA-style option cards for modem communications will limit users to 2,400-bps communications until 1993. Only the Compaq LTE Lite/25, LTE Lite/20, LTE/386s/20, Dell System 325N, and Toshiba T4400SX notebooks currently offer fast internal 9,600-bps modems.

NOTEBOOK COMPUTERS will shift from 5-volt to 3.3-volt operation by 1993, with the potential to double battery life. Look for hybrid systems later this year. 200MB hard disks will also be available next year.

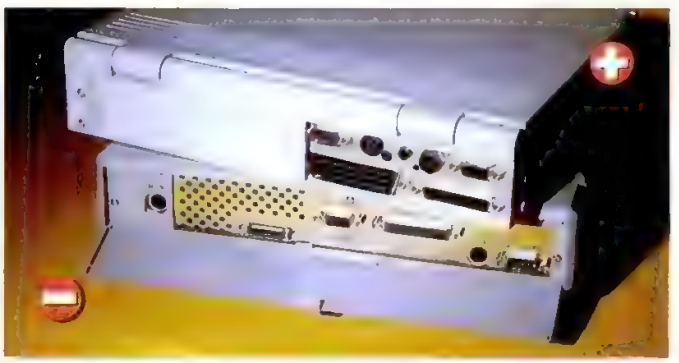
SUBNOTEBOOK COMPUTERS weighing 2 to 4 pounds (plus a half-pound floppy disk drive connected by a cable) will ship this summer. They'll have 386SX or 386SL CPUs and 1.8- or 2.5-inch hard disks. Most will have nonilluminated screens to stretch the battery life, and slightly compressed keyboards.

Make My Day: *User-Friendly Laptop Features*

It's the little things that make you love or hate your portable PC. Here's a thumbs-up, thumbs-down sampling of the features that make a positive or negative difference.

EIGHT CURSOR KEYS The four directional keys should be full-size and in an inverted-T layout, as on desktop PCs. There should be separate Home, End, PgUp, and PgDn keys. The middle photograph shows an inverted-T layout, but the keys aren't regulation-size, and they double as Home, End, PgUp, and PgDn—definite minuses. Two minuses go to systems with no inverted-T key layout at all.

REMOVABLE HARD DISK The removable hard disks on the Epson NB-5L systems make it a snap—literally—for several people to share one laptop without the hassles of loading and unloading personal files every time they hand off possession.



EASY-ACCESS CONNECTORS Rather than a mammoth single-hinged door, your notebook should have one small door for the commonly used connectors (mouse, modem, and transformer) and another for the less-used I/O ports (printer and expansion unit). Better still: sliding connector doors, which are less likely to break off.

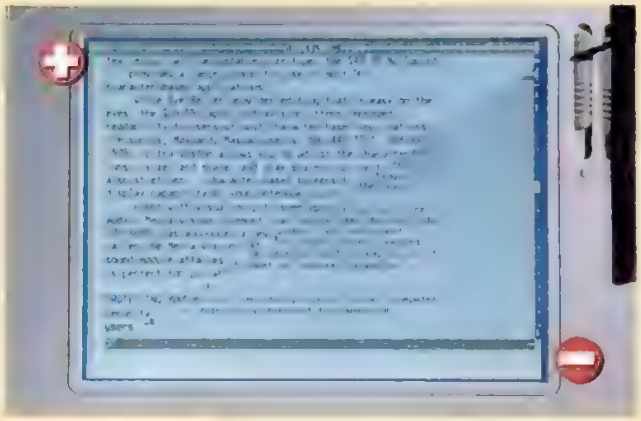
FULL-SIZE FUNCTION KEYS A real plus is full-width function keys that are in roughly the same position as on desktop keyboards. Note that there are 12, not 10. Tiny function keys are hard to manipulate. A good feature, though, is the red that distinguishes convenient user features, like the LCD/CRT toggle switch.

POWER-CORD FASTENER When you're in a hurry to pack your laptop and go, the Velcro fasteners on the Compaq LTE Lite series' transformers hold your power cord.

POWER TRANSFORMERS Small is in for road warriors, and nothing beats Toshiba's 21-ounce transformers. Compare these with NCR's 2.4-pound transformer.

ZDS PORT REPLICATOR ZDS's $149 port replicator provides the one feature all laptop users want—quick connections for all their cables—without the $750 to $1,000 expense of a docking station.

FIRST-CLASS SCREEN FOR COACH TRAVELERS Rear-hinged screens are a hassle when you're flying coach and the passenger in front of you reclines the seat. BCC's Avanti 025 and SL007 appear to be hinged in back, but as they open, their screens actually slide forward for a convenient viewing angle, no matter how cramped your work space.



INCOMPLETE DISPLAYS VGA text mode displays 400 pixels, not 480, from top to bottom. Many laptops draw a blank—literally—and leave vacant the top and bottom 10 percent of your display. If your system doesn't have a display-stretcher utility, get Laptop UltraVision, from Personics (800-445-3311, 508-897-1575).

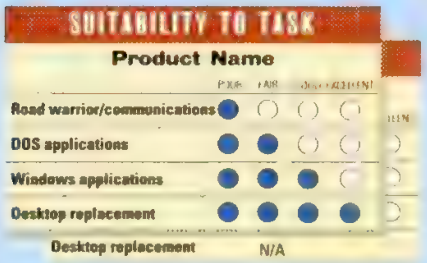
PCMCIA MODEM Tiny credit card–size slots can't hold anything more sophisticated than a 2,400-bps MNP 5 modem. The cards require a klunky adapter cord for converting from PCMCIA to RJ-11 (except the NCR Safari NSX/20, which has an integrated RJ-11 jack).

FLOPPY IN FRONT If your floppy disk drive loads from the front rather than from the right side, its access won't be obscured by a clip-on trackball. A floppy disk drive located on the portable's side can be problematic.

BUILT-IN POINTING DEVICES The Apple PowerBook puts PC laptops to shame with its large, readily accessible trackball. But any built-in trackball is better than none. The portables from CompuAdd, Compudyne, IBM, Sharp, and Tandy all include trackballs.

Suitability to Task: Monochrome Portable Computers

Only the systems from Dell, Gateway 2000, and NCR come close to combining the light weight, long battery life, and 9,600-bps data/fax modem support necessary to be excellent road warriors. And we could not find the ideal Windows notebook—with strong graphics capabilities, a built-in pointing device, a 120MB hard disk, and adequate power management for the graphical environment.



N/A—Not applicable. The product does not perform this task.

Road warrior/communications measures how complete a traveling companion your system is. Important factors include a light travel weight, a long battery life, and good communications options. The ratings for the necessary features range from *excellent* (a travel weight no more than 7 pounds, an excellent screen measuring at least 9 inches diagonally, exceptional power-conservation features combined with a good battery life, a 9,600-bps internal modem with 9,600-bps fax capability, and an 80MB hard disk) down to *poor* (a 40MB hard disk and a 2,400-bps modem). Systems without internal modem support did not qualify.

DOS applications describes each system's ability to run DOS software competently. An excellent system has at least a 25-MHz 386 processor. It must have an 80MB hard disk available, disk, memory, and video performance in the top 25 percent on PC Magazine Labs' Hardware Performance Tests, Release 6.0, and an excellent display measuring at least 9 inches diagonally. Systems rated as *good* feature a 60MB hard disk option, benchmark test performance in the top half of the monochrome category, and a display with at least an 8.5-inch measurement diagonally.

Windows applications are among the most demanding on any system, so we made this category particularly challenging. To be considered an excellent portable for this task, each system had to have memory expandable to at least 8MB, a 120MB hard disk available; Windows graphics performance in the top 25 percent, based on PC Magazine Labs' Graphics Winmark test score; a display measuring at least 9 inches diagonally; a built-in pointing device; and power management that works under Windows. None of the systems met these requirements. Good systems included an 80MB hard disk, performance in the top half of the monochrome systems reviewed, good displays, and a serial and a mouse port (or two serial ports).

To be considered a suitable **desktop replacement**, each system had to support a docking station or provide suitable internal expansion, have at least 386/25 performance, offer large hard disks, and support Super VGA on an external monitor. We also took the keyboard layout (or support of an external keyboard) into consideration.

Winmark scores of 2 million, with the Compaq Portable 486C on top with a Winmark score of 3.2 million.

NEW BATTERY TEST: ZDIGIT

Because battery life is so important, PC Labs and ZD Labs developed a more real-world battery rundown test that allows a system's power-conservation features to come into play. It's called the ZDigit Rundown test, so-named because a mechanical finger taps the keyboard every 10 minutes to bring hibernating systems back to life. ZDigit is an addition to our Battery Rundown test, which represents a near-worst-case scenario. On average, ZDigit battery-life measurements are one-third longer than those of the Battery Rundown test (see "ZDigit: Approaching Real-World Battery Life Testing.").

Intel and AMD both make strong battery-life performance claims for the efficiency of their 386 SL and SXL chips. The AMD chips have a slight advantage in terms of battery life (in proportion to the battery size in each system), but only by 5 or 10 minutes on a 3-hour system. Given the number of variables involved, we'd say that's not enough of a margin to allow bragging rights.

More important is the trend in battery-life improvement that all portables show. Some of that improvement is masked by vendors using smaller, lighter batteries, which is why we also report battery life both in hours and in hours per battery pound in our Battery Life vs. Portability charts. Straight battery life is not unlike a car's cruising range; the bigger the gas tank, the farther the car travels. Battery life per battery pound is a measure of efficiency, like miles per gallon.

The average for all monochrome notebooks was 2 hours 50 minutes; the median (half the machines were better, half were worse) was 2 hours 28 minutes. (The five battery-powered color systems each averaged 2 hours 6 minutes.) Nearly a third of the monochrome systems, 20 units in all, lasted at least 3 hours on our Battery Rundown test, with 2 systems reaching 4 hours: the TI-built Gateway Nomad 425DXL (486DX/25) and the NCR (formerly AT&T) Safari NSX/20 (386SX/20). Another 24 systems managed 2 hours or better, and 21 systems were below 2 hours.

SUITABILITY TO TASK

If you were to create an ideal portable, selecting from a composite of what is available today, it would probably weigh 5 to 6 pounds; have a 25-MHz 486SX CPU, a 16MB RAM capacity, a 120MB hard disk, fast video performance, the ability to

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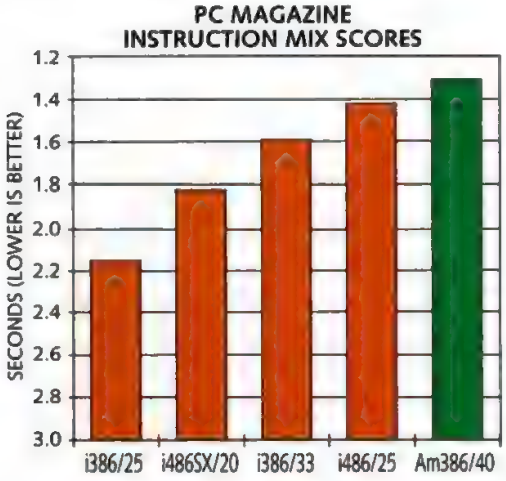
Want the fastest 386?

Why settle for anything slower, the 40 mhz Am386DXL from Advanced Micro Devices is the fastest 386 chip on the market, hands down. Not only does it outperform all other 386 chips, it even outperforms many 486 processors too. When looking for a 386 or 486 PC, look for the Am386DXL-40; it's over 20% faster than 33mhz 386 processors, over 31% faster than the Cx486SLC-25, over 50% faster than the i486SX-20, and over 13% faster than the i486SX-25 (in MIPS as tested by Power Meter vers. 1.5). The data speaks for itself - don't *pay more* and *get less.*



According to a Jan. 14 1992 PC Magazine Review, the Am386/40 was faster than all other 386 processors, it was even faster than most available 486 processors!

Look under the hood.

The AMD processor is easy to spot. Just look for the logo to the left. It's the only way to get the fastest 386 performance at the price of an ordinary 386 PC.

More Power Per Dollar.

Not only is the Am386DXL-40 faster than the i486-25, it's a better value too! The AMD chip costs a lot less than the price of the

Compare the cost of the Am386DXL-40 against the i486SX-25 and the faster Am386 chip actually costs less! FastMicro really stretches your computing budget.

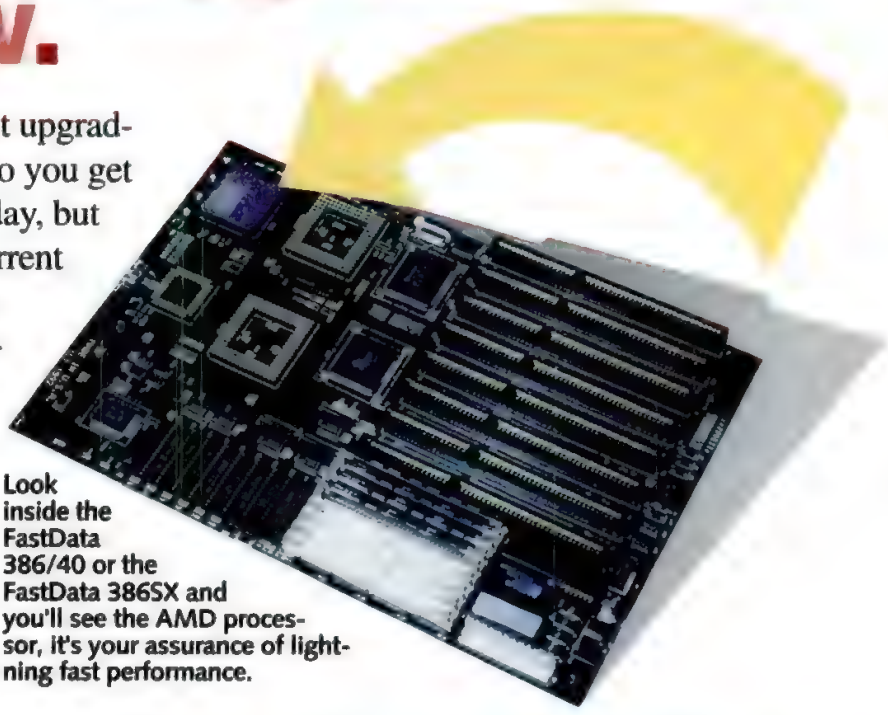
486SX and FastMicro passes the savings and performance gain on to you. Plus, there is no sacrifice in upgradablility - read on!

Certified Compatible - of Course.

The Am386 processor family is certified compatible with all 386 compatible hardware and software. It has flawlessly passed tests from every top computer publication and has been tested in over 100 different 386 systems (including FastMicro's) and passed all tests without a single failure or incompatibility. Its compatibility has even been certified by XXCAL Testing Labs.

Buy Today - Upgrade Tomorrow.

The FastData 386-40 is the most upgradable PC on the market! Not only do you get the most power for your money today, but you can upgrade your system to current and future 486 processors. Unlike competitors' very expensive proprietary upgrade cards, all you do is plug in a new processor & a $20 clock crystal (the silver part at the top center of the board) and change some jumper settings. Processors & crystals are widely available. You can install i486DX, i486DX/2, i486SX, announced AMD 486 CPUs & even promised next generation upgrade processors, all up to 50mhz external clock rate (100mhz for DX/2s and other doubler designs). That's more flexibility than other companies' 486 computers. FastMicro really maximizes value today and protects your investment tomorrow!



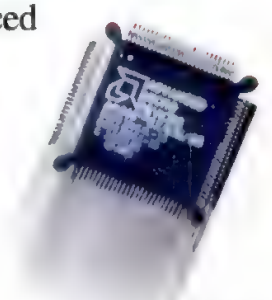
Look inside the FastData 386/40 or the FastData 386SX and you'll see the AMD processor, it's your assurance of lightning fast performance.

BUYER'S CHECKLIST

	FastData 386/40	Other 386's	Other 486SX's
386 Priced	X	X	
40mhz Performance	X		
486SX Overdrive Ugr.	X		X
486DX Upgradeable	X		
486DX2 Upgradeable	X		
Cache Upgradeable	X		?
170mb Conner Drive	X		
7 Drive Bays	X		
Dual Cooling Fans	X		
GE On-Site Service	X		
7th Year in Business	X	?	?

The Fastest 386SX Too!

The latest high performance 386 processor from Advanced Micro Devices is the Am386SXL-33. It's 32% faster than 25mhz 386SXs and combined with FastMicro's 16K optimized cache, it boosts performance to 74% above normal 386SX-25 levels.



FastMicro's got the new Am386SXL/33

FastMicro includes the fastest 386 chips.

Don't settle for less, FastMicro's new 386/40, 386SX/25 & 386SX/33 utilize high performance 386 processors and do it at a price that will make ordinary 386 PCs obsolete. Plus FastMicro backs every PC with its award-winning support and service. Turn the page to learn more!

FASTMICRO PRESENTS THE FASTEST 386 PC'S

FastData 386/40

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INCLUDES

- Am386DXL™ 40mhz Processor
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- **Upgradable to 486 Processors.**
- 4 megabytes of high speed RAM.
- **170 mb 17ms IDE hard disk, 1:1 interleave with 32K cache.**
- 1.2mb 5.25" & 1.44mb 3.5" drives.
- New Generation Desktop Case.
- 72hz Non-Interlaced 14" Super VGA color monitor, 1024x768 resolution.
- **16 bit SVGA card with 1mb Ram, 32,768 Colors & Windows Accelerator.**
- Clock calendar, parallel port, game port and two serial ports.
- 8 expansion slots, 2 occupied.
- Microsoft Windows 3.1 & Mouse.
- MS-DOS 5.0.
- FastMicro Peace of Mind.

A System That's Cool & Quiet? FastMicro Innovates.

Every new desktop FastData PC comes with dual cooling fans. It has a main fan that's quieter than fans in ordinary PCs- plus, it includes a special second fan that comes on only when the system gets warm. A cooler system lasts much longer - a concern particularly when upgrading to higher heat-producing clock doubler chips.

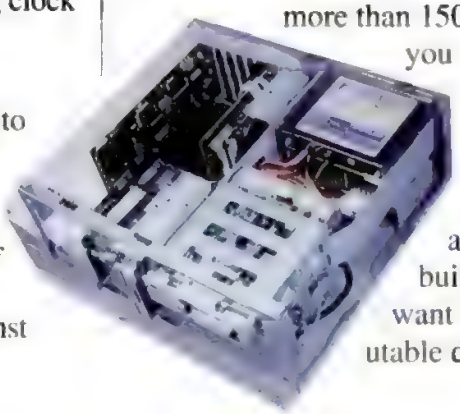
Fourth Generation Case

Our new desktop case has been developed to afford maximum strength, expandability and protection in a versatile and compact design. From the minute you look inside, you know this is not like the minimum cost cases most of our competitors use. It includes no less than seven drive bays and has extra protection against radio interference.

Powerful 170 Mb IDE Drive.

FastMicro includes Conner's CP-30174 170mb IDE hard drive standard in the FastData 386/40. Conner has a reputation for building the most reliable drives on the market, in fact, the CP-30174 has a MTBF (mean time between failures) rating of more than 150,000 operating hours. If you ran your FastData system 24 hours a day - that's more than *17 years*! Couple this with a <17 millisecond access time and 32K built-in cache and you won't want to gamble on a less reputable drive.

CONNER



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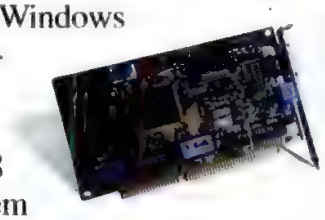
Order the FastData 386/40 and we'll include a High Performance Windows Video Accelerator Card at no extra charge. Its Tseng Labs ET-4000 graphics accelerator runs Windows *five times* faster than standard VGA cards and its Sierra Ramdac Hi-color chip delivers up to 32,768 colors. We top your system off with a Non-Interlaced Super VGA monitor with resolutions to 1024 x 768 and a sparkling *72hz* refresh rate. Order either of our Am386SXL models and we include the non-interlaced monitor with a 1mb Super VGA Card (it's three times faster than standard cards).



Remember, when you buy from FastMicro, you can choose from hundreds of hardware and software products to enhance your system.

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Upgrade your FastData 386 system to the PC Magazine Editors' Choice Diamond Stealth VRAM and the PC Magazine Editors' Choice MAG Colorview/15 15" Super VGA Monitor for just $399

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FastMicro backs up all FastData PC's with the most comprehensive service in the business. Seven day a week toll-free technical support is included for as long as you own your FastData PC. In the unlikely event a part should fail during the one year warranty, we'll express ship you the replacement part. If we still can't resolve the problem, we'll send GE on-site or replace the system at no charge.

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"FastMicro has lasted while scores of other companies have come and gone"
-Computer Buyer's Guide 10/91

Why buy your PC from one company and your software and peripherals from another? FastMicro supports you better with our complete inventory of all the leading computer products at low FastMicro prices.

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- Am386SXL™ 25mhz Processor
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- 72hz Non-Interlaced 14" Super VGA monitor, 1024x768 resolution.
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- Clock calendar, parallel port, game port and two serial ports.
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CIRCLE 032 ON READER SERVICE CARD

1992 Service and Reliability Survey

8,592 *PC Magazine* subscribers answered our survey on service and reliability in the PC industry. Here's how they rated 14 of the top laptop and notebook vendors for overall product reliability, service, and support, along with the likelihood of buying again from the same vendor.

The 1992 *PC Magazine* Service and Reliability Survey was published in our May 26, 1992, issue. The following tables summarize the numerical results from the laptop and notebook computer section of our survey.

These *PC Magazine* subscriber ratings of laptop and notebook PC manufacturers are based on 8,592 responses and cover those brands the participants used in the past two years.

We calculated an average score for each manufacturer, based on responses reported on a scale of 1 (the lowest rating) to 10 (the highest rating). As with any sample survey reporting average ratings, there is a margin of error associated with each score; small differences in ratings may not be significant. This was taken into consideration when we conducted the analysis. For more details, see our May 26 issue.

The 1992 PC Magazine Service and Reliability Survey

LAPTOPS AND NOTEBOOKS (BY MANUFACTURER)

Overall PC reliability		Future likelihood of buying from the vendor		Satisfaction with repair service		Satisfaction with technical support	
Zeos International Ltd.	9.18	Dell Computer Corp	8 53	Dell Computer Corp.	8.89	Dell Computer Corp.	9.12
AST Research Inc.	8.91	AST Research Inc.	8 33	Zeos International Ltd.	8.57	Zeos International Ltd.	8 66
Toshiba America Information Systems Inc.	8.81	Zeos International Ltd.	8 28	AST Research Inc.	8 26	AST Research Inc.	8.06
Dell Computer Corp.	8 80	Toshiba America Information Systems Inc	7 65	Compaq Computer Corp.	7 94	Compaq Computer Corp.	7.79
Compaq Computer Corp.	8.74	CompuAdd Computer Corp	7 44	IBM Corp	7 83	CompuAdd Computer Corp.	7.67
Tandy Corp./GRiD Systems Corp.	8.67	Compaq Computer Corp.	7 18	Toshiba America Information Systems Inc.	7.65	Toshiba America Information Systems Inc.	7.63
Texas Instruments Inc.	8 63	Texas Instruments	6 75	CompuAdd Computer Corp.	7.50	IBM Corp.	7.61
IBM Corp	8 57	Sharp Electronics Corp.	6 63	Bondwell Industrial Co.	7.43	Bondwell Industrial Co.	7.41
Bondwell Industrial Co. Inc.	8.51	Bondwell Industrial Co.	6 60	Tandy Corp /GRiD Systems Corp.	7.32	Tandy Corp./GRiD Systems Corp.	7.33
Epson America Inc.	8 46	IBM Corp	6 11	NEC Technologies	7.27	Epson America	7.06
CompuAdd Computer Corp.	8 45	Tandy Corp./GRiD Systems Corp	5 98	Sharp Electronics Corp.	7.15	NEC Technologies	7.00
NEC Technologies Inc.	8.28	NEC Technologies	5 81	Texas Instruments	6.93	Texas Instruments	6.72
Sharp Electronics Corp.	8.26	Epson America	5 48	Zenith Data Systems	6.78	Zenith Data Systems	6.70
Zenith Data Systems	7.97	Zenith Data Systems	5 40	Epson America	6 69	Sharp Electronics Corp.	6 53
Average	**8.59**	**Average**	**6.87**	**Average**	**7.59**	**Average**	**7.52**

Scale: 1 (lowest rating) to 10 (highest rating)

drive the built-in LCD panel and an external monitor simultaneously, a nickel hydride battery and intelligent power management that together deliver 3 to 4 hours of continuous-on battery life, a small quick-charge transformer, a built-in pointing device, eight (not four) cursor/page movement keys, and a slot for a 9,600-bps data/fax modem (PCMCIA slots won't do). The monochrome system should cost you about $3,500, and an active-matrix color system about $5,000.

Among the 80 systems we review, no one unit provides all these features, and the ones that provide most of them may carry a premium. To help you focus on the features that matter to you, we have added Suitability to Task ratings that measure each portable system's applicability for use in four areas:

- e-mail, communications, and general-purpose road warrior;
- DOS workstation;
- Windows workstation;
- and Desktop replacement (the portable is your system).

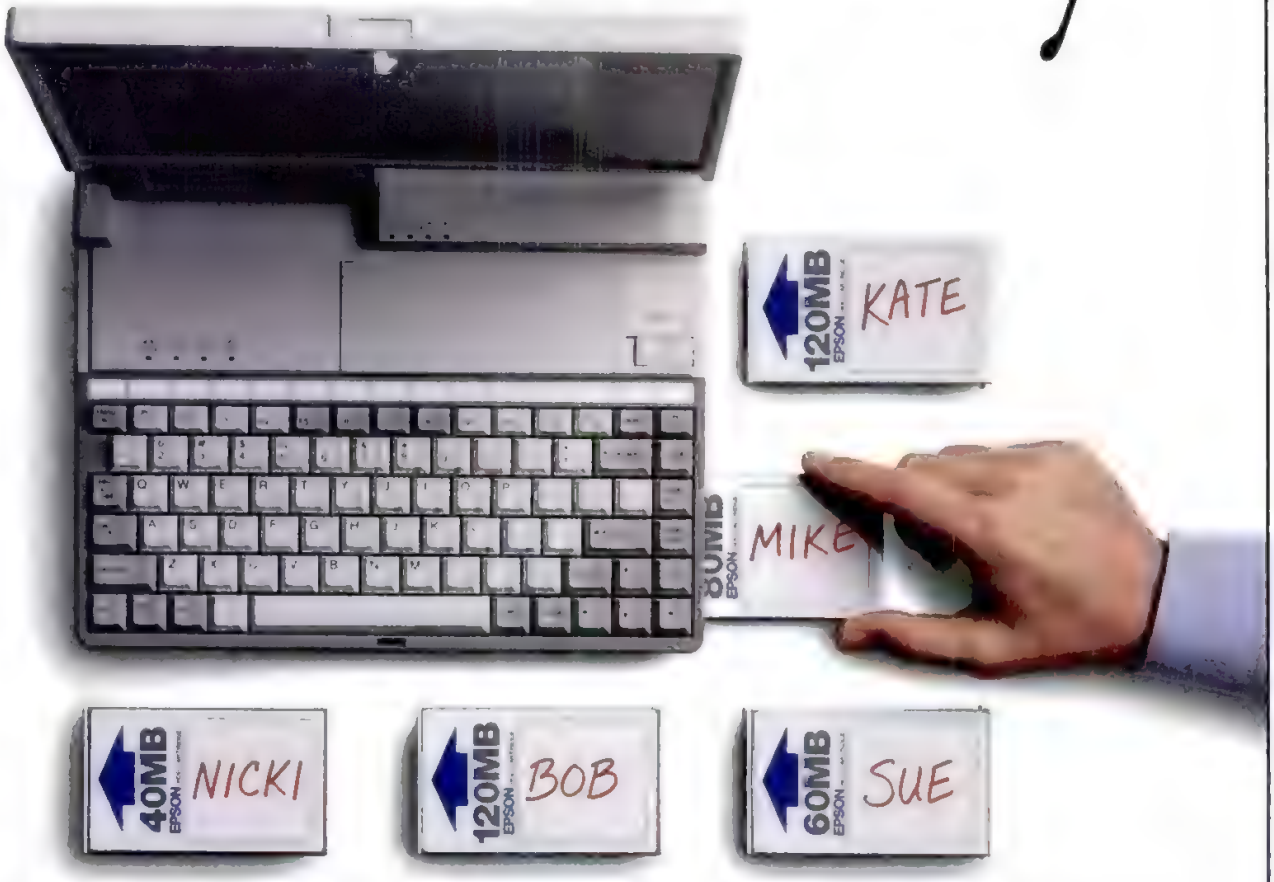
Rather than grade on a curve, which ensures that some fraction of the machines would receive scores of Excellent on each task, we set criteria based on what we believe users want, even if today's technology is slow to provide it. For instance, because Windows applications are such disk-space hogs, and because we believe clip-on pointing devices (such as Microsoft's BallPoint Mouse and the Logitech TrackMan Portable) are terminally clunky, our scoring for the Windows portion requires a 120MB hard disk and a built-in pointing device (not a bundled, clip-on unit) to be eligible for the Excellent rating in this category. Likewise, to receive a score of Excellent for Road warrior/communications, we require an internal 9,600-bps data/fax modem.

TRENDS: 486SX, 3.3 VOLTS, 120MB

Based on the portable systems we review here and those systems looming on the horizon, we see these trends emerging:

- By year's end, the 486SX or 486DX will be the CPU of choice for performance-oriented business users as Intel compresses the prices for 386SX, 386SL, and 486SX chips and introduces lower-power versions of the 486 line. The 486SX/25 systems in this review run three to four times as fast as the slowest of the 386SX systems. (The 486SX is a 486DX minus the math coprocessor.) All told, six of the monochrome notebook systems and nine of the color/specialty systems had 486SX or DX CPUs. Later this year, AMD will enter the market with two low-power 486-compatible chips—the Am486DXLV-20 and Am486DXLV-25. Note that as portables get smaller, chip names seem to get longer; it's possible that within a year or two the product name may no longer fit on the case.
- Low-voltage PCs will substantially improve battery life. Hybrid systems using a combination of 5-volt and 3.3-volt components will appear this year, more to give the engineers experience than to give you gobs more battery life. Early next year, we will see systems, primarily 486-based, that use 3.3-volt components exclusively. They have the potential to wring twice as much life from a battery and use alkaline batter-

Seats Five Comfortably.



You can't fit five hard-working people into just any notebook computer. But the Epson® NB-SL™ line features a unique, removable, pocket-size hard drive that's loaded with possibilities. So now, armed with their own removable drives, any number of users can share one NB-SL without sharing data.

What's more, these drives are extremely easy to transport or lock away for extra security. You can even create a library of drives, each with its own type of information. Or, add an optional adapter and plug your drive directly into your desktop computer.

To find out more about the NB-SL, call **800-289-3776** for our free demo diskette, and the name of your nearby Epson dealer. Then round up three or four friends and come in for a test drive.

EPSON

Desktops Dot Matrix Notebooks Lasers Servers

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ies as permanent or temporary power sources.

- Hard disk manufacturers are finally beginning to deliver 120MB 2.5-inch disks in quantity, releasing a pent-up demand from users who found that 80MB just isn't good enough. Look for 200MB floppy disk drives by early 1993. Even smaller, 1.8-inch disks are now becoming available, but capacities are comparatively wimpy (20MB to 40MB currently). Until they pass 100MB (by 1993), they will be targeted at subnotebooks and tablet systems, not notebooks. Further out on the horizon are low-powered hard disks, especially designed for low-voltage systems.
- Active-matrix color portables will continue to command hefty, relatively unchanged premiums of about $2,000 over the cost of comparable monochrome systems. While the viewing quality of less desirable passive-matrix color portables won't get much prettier, as the premium relative to monochrome systems falls from $1,000 to well under $500, passive-matrix systems will entice buyers who reason thus: No matter how washed out, it's got to be better than staring at a monochrome display.
- Among notebook alternatives, we will see useful products in the subnotebook, or almost-notebook, category comprising systems weighing 3 to 4 pounds each. These subnotebooks have a slightly squeezed keyboard, a hard disk, and a nonilluminated display. We have been generally dubious about no-floppy portables in the past, as have buyers (all no-floppy laptops to date have flopped), but that's because add-on floppy disk drives weigh 2 to 3 pounds each; now they are less than a pound each and almost fit in your shirt pocket. Look to Dell to be among the first to ship; we viewed Dell's 3.5-pound Voyager this spring.

The category comprising pen-based (also called tablet or slate) computers remains immature. Regardless of what you may hear or read elsewhere, there's not much useful hardware or software ready to go. Pen computing will be an enormous market, but not this year. As with subnotebooks, tablet makers are leaning toward lighter systems with nonilluminated displays. The ones we have seen so far are pretty hard to read.

- PCMCIA (Personal Computer Memory Card International Association) slots for accessory cards are appearing on more systems. The size of a thick credit card, a PCMCIA card can hold system RAM, flash (nonvolatile) memory of up to 20MB, execute-in-place software burned onto ROM chips (meaning the program runs from ROM without being loaded into RAM), slower-speed modems, and network adapters (sometime next year). We believe any vendor who uses the PCMCIA slot for the modem made a big mistake, because PCMCIA's limited real estate currently restricts modems to 2,400 bps. Of the reviewed systems, four feature PCMCIA slots: the NCR System 3170, Sharp PC-6781 Notebook, TI TravelMate 3000 WinSX, and Toshiba T3300SL.
- Despite the growth of Windows, which demands a pointing device, only a handful of products have built-in trackballs, and they are halfhearted efforts compared with the front-and-center trackball in the Apple's PowerBook systems. Of the PC products reviewed here, systems from CompuAdd Express, Compudyne, IBM, Sharp, and Tandy have built-in pointing devices, all with different implementations.

IN THIS ISSUE

Immediately following this introduction are the reviews of the 65 battery-powered monochrome notebook systems. The color and specialty portables are reviewed in a separate feature. As is *PC Magazine*'s custom, the PC reviews are arranged in alphabetical order by company name. Where two or three essentially similar systems are sold by different companies, they are grouped together: Altec, Austin, and Tenex; Blue Star and Micro Express (386/25s); Blue Star, Micro Express, and MicroStar (386SX/25s); Matrix Digital, Mitsuba, and Packard Bell; and Polywell and Positive Corp. are a few examples. We tested each system individually, rather than using one of the twins or triplets to stand in for its sibling.

Austin 386SX-25 Notebook, Altec 386SX/25 Notebook, Tenex NB25SX

Altech Technology Corp.

Altec 386SX/25 Notebook

Austin Computer Systems Inc.

Austin 386SX-25 Notebook

Tenex Computer Express

Tenex NB25SX

Indistinguishable from each other on the surface, the $2,345 Altec 386SX/25 Notebook, $2,195 Austin 386SX-25 Notebook, and $2,095 Tenex NB25SX each measures 2 by 11 by 8.5 inches (HWD) and weighs 6.3 pounds with its nickel cadmium battery installed. When the three are stacked against the rest, they share average performance, along with average appearance and price; when compared with one another, the Tenex has a longer battery life, superior service and support, an included 2,400-bps data/4,800-bps send fax modem, and a lower price.

Each one of these Sampo (Taiwan) clones has a power-conserving Am-386SXL/25 processor and accepts up to 8MB of RAM in proprietary SIMM slots.

SUITABILITY TO TASK

Altec 386SX/25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

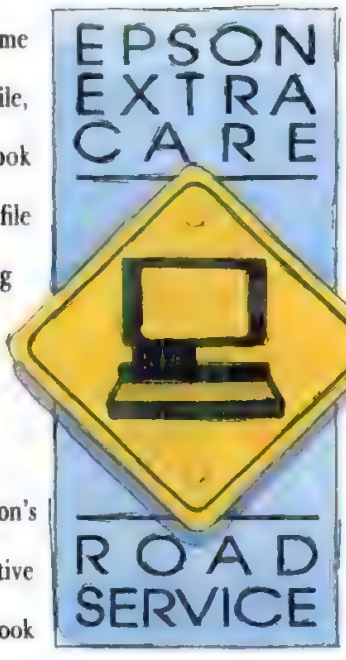
Travel Insurance.

There you are, slaving away in some nondescript motel room in Mobile, Moline or Modesto when your notebook computer suddenly refuses to open the file containing the speech you're giving tomorrow.

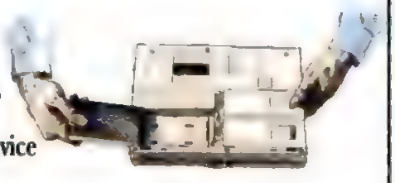
You're sunk, right? Not if your notebook is an Epson® NB-SL.™

The NB-SL, you see, comes with Epson's Extra Care Road Service,™ an innovative support program (free while your notebook is under warranty) that puts expert technical assistance just an 800 number away.

If we can't fix your computer over the phone, we'll overnight you a replacement unit free, anywhere in the United States.



And because the NB-SL features a unique removable hard drive, you won't lose one bit of your precious data—or much precious time—in the process. Simply slide the drive out of the old notebook, pop it into the new unit, and you're ready to go again. It's fast, hassle-free, and won't cost you a cent.



Of course, it's not just service and support that make the NB-SL so superior. For the rest of the story, call **800-289-3776** for our free demo diskette, and the name of the Epson dealer nearest you.

The Epson NB-SL notebook with Extra Care Road Service. You could say it's like having a technical expert with you at every turn.

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CIRCLE 066 ON READER SERVICE CARD

ZDigit: Approaching Real-World Battery Life Testing

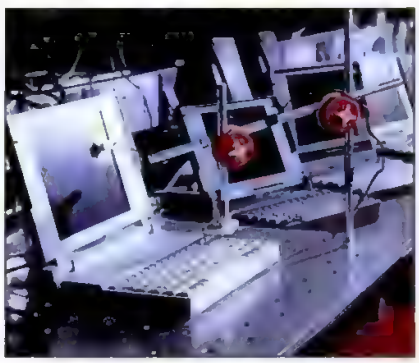
by Nick Stam

With this issue, *PC Magazine* introduces the ZDigit Rundown test. The collaborative effort of PC Magazine Labs and ZD Labs, ZDigit is an automated battery-testing system that approximates a PC's typical, real-world power consumption: Notebook PCs run this test with power-conservation features enabled.

ZDigit uses a combination of hardware and control software to measure battery duration. The software component runs on both the tested notebook and a second control PC. The notebook-based software exercises the system with a "real-world" workload: repeated sequences of video and hard disk activity followed by periods of inactivity, until the battery is drained. (To see a worst-case scenario, PC Labs also runs the Battery Rundown test, for which the notebook's power-management features are disabled. The two results more clearly show the expected battery life.)

The basic ZDigit hardware consists of a custom mounting platform that holds up to two notebook PCs, keystroke actuators affixed to robot arms, and photo sensors. Each robot arm is highly maneuverable so that a keystroke-actuator mechanism can be positioned over virtually any key on the notebook. During testing, a photo sensor is mounted directly onto the notebook's screen to determine screen illumination. A second, control PC outputs commands to activate the keystroke actuator and receive photo-sensor inputs. The control-PC's I/O is handled through a serial port and a game port, which are connected to a custom interface unit. This unit provides the actual link between the control system, keystroke actuator, and photo sensor.

Three software test phases are used to exercise the notebook and drain the battery; the active phase, the idle phase, and the sleep phase. PC Labs chose 2 minutes for the active phase, 2 minutes for the idle phase, and 10 minutes for the sleep phase. (We configure the power-conservation features on all the portables the same way. We set the hard disk and screen to time out after 2 minutes, and we disable any notebook-initiated standby modes.)



The ZDigit test platform in PC Labs.

During the 2-minute active phase, the notebook-based control software performs computations and writes time stamps to the notebook's display and hard disk. Every 15 seconds during the active phase, the control PC signals the keystroke actuator to depress one of the notebook's keys, keeping the screen illuminated. Each keystroke also resets the notebook's screen timeout counter to 2 minutes.

During the 2-minute idle phase, the notebook-based control software does not write to video or disk, allowing the notebook's hard disk to spin down and its LCD to blank. What follows is a 10-minute sleep phase (not to be confused with built-in notebook power-management sleep or standby modes), a period of inactivity for the notebook. During this sleep phase, the control software running on the notebook is idle, and some notebooks can reduce the CPU speed and power consumption.

The entire three-phase cycle repeats continually until the battery is drained. Since notebooks are inactive for a total of 12 minutes between each active phase of the test process, the timing accuracy of ZDigit scores is plus or minus 12 minutes. □

All three systems were tested with 4MB of RAM, and while the Altec and Tenex featured 80MB Conner IDE hard disks, the Austin had a 60MB Conner IDE unit. All paired a Cirrus Logic GD610/620 chip set and 256K of video RAM with a Sharp 10-inch monochrome screen displaying 32 shades of gray at VGA resolution.

SUITABILITY TO TASK

Austin 386SX-25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

If you're looking for remarkable battery life and a power-conserving 386SX/25 processor, each of these is worth considering. A Battery Rundown time of 3 hours 25 minutes put the Tenex ahead of the Altec and Austin, both of which were just shy of 3 hours but lasted longer than three quarters of the 25-MHz machines we tested. These three were at the head of the class on our new ZDigit Rundown test, which by contrast is conducted with the notebooks' power-conservation features enabled. The Tenex placed fifth, with a score of 5 hours 15 minutes. The Austin ran for 4 hours 48 minutes and the Altec just 1 minute less. Power-conservation features, the same on all three notebooks, include a sequestered suspend/resume button above the keyboard next to the power switch; auto standby; plus screen and hard disk savers.

SUITABILITY TO TASK

Tenex NB25SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The new ZEOS®/SL Notebook is turning a few heads.

Including its own. And that's just for starters!

ZEOS has taken years of notebook experience and designed the perfect notebook. Feature for feature, there is simply nothing else like it.

And because the new ZEOS/SL is designed and built by ZEOS we can offer it at prices that will send the competition reeling. Maximum features, minimum prices — It's the notebook you've been waiting for.

The new ZEOS /SL. Read all about it!

Digital brightness and contrast buttons make screen adjustment so easy.

This fine Italian leather carrying case is an additional option. Loaded with pockets and features everyone will appreciate.

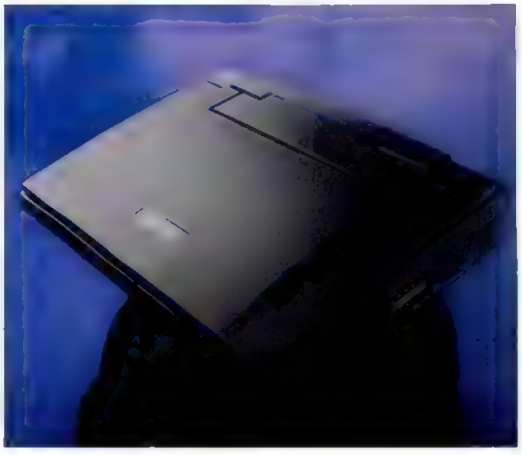
This sliding port door won't break off or come loose. Saves your fingers too.

an external VGA color monitor for simultaneous co-display. Now that's what people want! But that's not all.

A NOTEBOOK KEYBOARD YOU'RE GOING TO LOVE.

Can't someone design a notebook keyboard to be like a desktop keyboard? And while you're at it, be sure to include a pointing device that's easy to use, with three click keys. And how about making sure those cursor keys are *full size* and in the inverted-T format. And all the keys should have good travel and that "just right" ergonomic feel. That was the keyboard wish list.

So we designed it. From scratch. Every key was re-designed and re-sculpted. Even the key-switch mechanism was invented anew. And we added the mouse key for easy cursor control. It is the absolute perfect notebook keyboard. What else?



Lots else! Like the best display system of any notebook available anywhere. We listened here too. The screen is 10" big and it's easy to read. Plus, it's high contrast and it's fast. It's also very easy to adjust. People said contrast and brightness knobs were hard to use. So we replaced them with soft touch buttons that *electronically* adjust screen settings at your command. Then we really got creative.

THE ONLY NOTEBOOK WITH A TILT & SWIVEL DISPLAY.

Your new ZEOS Freestyle/SL is the only notebook in the world with a screen that tilts, swivels and floats!

Can you imagine your desktop PC without a tilt and swivel display? Neither could we. So why not incorporate that feature into a notebook. With the ZEOS Freestyle/SL notebook you can adjust the screen left and right as well as up and down. Now you can truly adjust your notebook screen to the perfect viewing angle.

This comes in handy in other ways as well. It's easy to share data with a person sitting next to you by turning the screen; or if privacy is in order, turn it away so only you can see it. Every frequent flier will appreciate that!

IT FLOATS TOO!

And then there is the "floating" screen. When you're facing your new ZEOS Freestyle/SL, the screen actually appears to "float" in the air in front of you. Adjustable over a wide range of angles, it's the only notebook that can really be used sitting on your lap! Back to our frequent fliers. Because the screen floats on a smaller footprint than normally hinged screens, you can also use the ZEOS Freestyle/SL without fear of the person in front of you cranking their seat back and doing a "screen crunch" on your system.

Reliability is truly designed in from the ground up in your ZEOS Freestyle/SL. Right down to the port access door. People told us that one of their pet peeves was port access doors falling off competitors' notebooks. Not a problem here. Your industry standard serial, parallel and VGA port connectors are protected by an ingenious sliding door that won't ever fall off.

EXTRA, EXTRA, EXTRAS. READ ALL ABOUT 'EM!

With all its features, we might have stopped

Measuring only 8.5" x 11.3" just like a notepad! Easily fits into a briefcase yet at 5.6 pounds packs all the wallop of a desktop!

there. But we didn't. We've made more options available than ever before. Like our 14,400 bps V.32bis, V.42, MNP5™ modem with 9,600 bps send/receive fax. And memory up to 20MB, hard drives to 180MB, even an optional Italian leather carrying case! Extra batteries and a charging stand are available too. Call 800-423-5891 for all the details.

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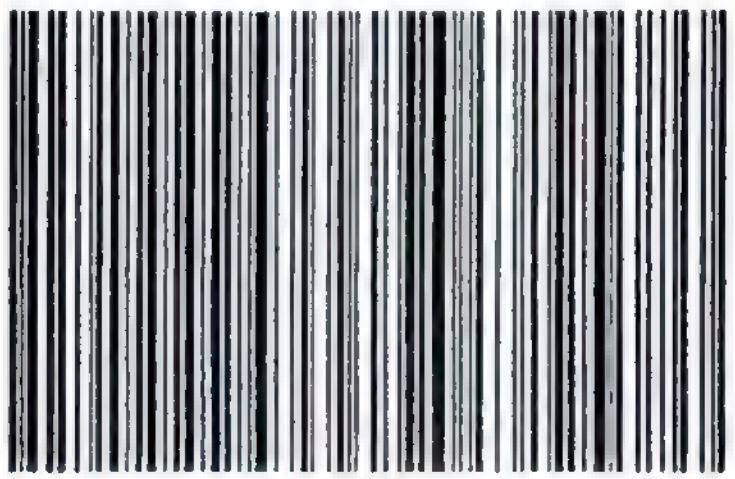

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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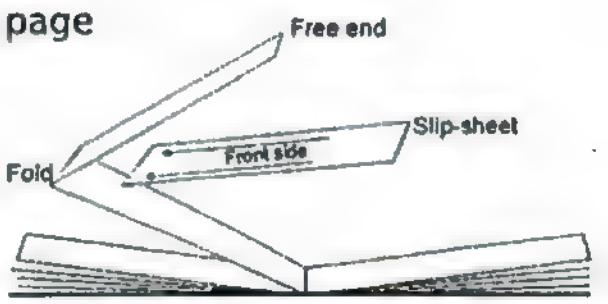
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

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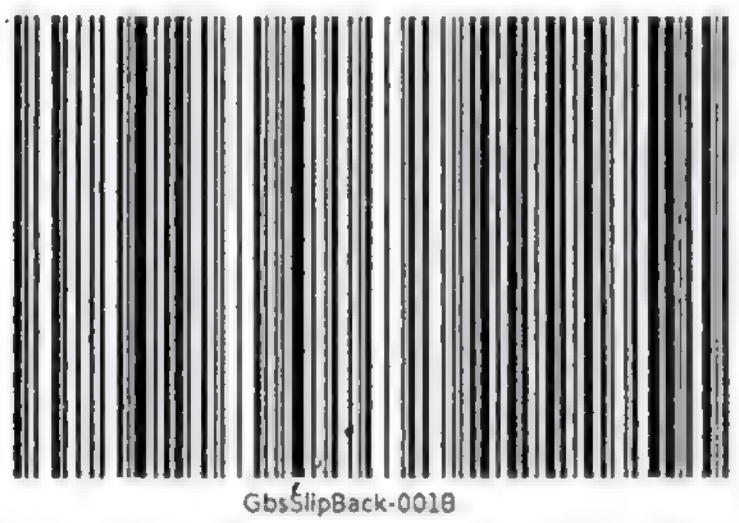

Back

1. Follow instructions on the other side

The only notebook with a tilt & swivel display. Great for sharing data or keeping it private. Easily adjusts for perfect viewing.

Built-in mouse key provides easy cursor control. Leave those bulky mice behind!

ZEOS® Freestyle/SL 2MB, 60MB Only $1895

MORE FEATURES AT A LOWER COST THAN ANY OTHER NOTEBOOK. PERIOD.

To try and compare the new ZEOS Freestyle/SL to any other notebook on the market is next to impossible. Because nothing else has all its features. And even with all these great features, nobody can match the price. Features and price. It would seem the new ZEOS Freestyle/SL is the best of all worlds. It is.

DESIGNED BY USERS. JUST LIKE YOU!

That's why we started from scratch. We asked our customers, people just like you, what it is they want in the perfect notebook. The result is perhaps the first truly American notebook. Not designed by some big outfit in a faraway place. But by ZEOS and our customers. We did it together and we think you'll like the results.

The first thing people told us is that most notebooks look like a cigar box with a lid. They told us they wanted more. Not only good looks, but things like great power *and* great battery life. Lightweight too, like five pounds and change. And the display had to be both crystal-clear as well as functional. And the keyboard should be effortless to use. The entire product had to be extremely durable. And that was just for starters.

SL POWER. SL BATTERY LIFE!

We listened well. Then we got down to work. For the chipset and CPU we selected the Intel 25MHz SL. We then built in a high-speed 64K SRAM cache as standard. We know this system might well replace a desktop for many users.

PC Magazine said the SL chipset is "the way to go" and we agree. The ZEOS Freestyle/SL incorporates the very latest in power-saving features. You can easily go in and out of the various power-saving modes automatically as well as use our "Windows Safe" suspend/resume feature. In addition, the ZEOS/SL features *flash BIOS* enabling you to easily update your BIOS in the future via diskette or modem.

Power to your ZEOS Freestyle/SL system is provided by our advanced battery system. The fully enclosed lightweight battery packs easily snap in and out and can be "quick-charged" when the system is not being used or trickle-charged when in use. An optional charging stand is also available. You're also going to like our super-small AC adaptor—it can fit in a shirt pocket and weighs only ounces. So what happens when the power is on?

GREAT VIDEO TOO!

You get great video! Because for video control, we chose the amazing new Cirrus Logic VGA controller. Also made especially for notebooks, it not only consumes less power, it also produces the fast crisp images you're looking for. And with a business machine like this you'll also appreciate our dual display capabilities. You can connect

"Only ZEOS's portable PCs achieved significantly higher-than-average ratings in all four categories."—PC Magazine, Service and Reliability issue. May 26, 1992

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Please complete all appropriate sections, *providing at least two years residence and employment history. THIS IS NOT A CREDIT AGREEMENT!* One will be sent to you upon authorization of an account. (This form must be signed to process your order.) All financed purchases are subject to credit approval. *If you have any credit questions, please call 800-421-8942 for assistance.* Thank you!

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Home Phone (____) _____

Soc. Sec. No. _____ Date of Birth ___/___/___

Address _____ Apt. ____

City _____ State ____ Zip ____

Since? (Mo./Yr.) ____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State ____ Zip ____

Employer _____ Since? (Mo./Yr.) ____

Monthly Gross Salary $ _____ Daytime Bus. Phone (____) _____

Previous Employer _____ From ____ To ____

Occupation _____

A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT.** Do not complete Section C.**

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☐ married ☐ unmarried ☐ legally separated

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income $ _____ Source: _____

Name & Address of Nearest Relative Not Living With You _____

_____

Relationship _____

B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE A:

Checking Account ☐ Yes ☐ No

Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept. Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ___/___/___

Address _____ Apt. ____

City _____ State ____ Zip ____

Home Phone (____) _____ Date of Residence (Mo./Yr.) _____

Joint Applicant's Employer _____ Since? (Mo./Yr.) ____

Bus. Phone (____) _____ Monthly Gross Salary $ _____

CUSTOMER AUTHORIZATION

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature _____

Date _____

Joint Applicant's Signature _____

Date _____

FOR MARRIED WISCONSIN APPLICANTS: I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature _____

Date _____

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800 421 8942 or 612 635 0613 or write to ZEOS, Z Card Processing Center, 530 5th Avenue N.W., St Paul, MN 55112

NY – A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH – The Ohio laws against discrimination require that all creditors make credit equally available to all creditworthy customers and that credit reporting agencies maintain separate credit histories on each individual upon request. The Ohio Civil Rights Commission administers compliance with this law.

*Financing not available in Alaska, Hawaii or outside the continental U.S

ZCDIT-PCM-9208

Z-CARD PRIORITY APPLICATION FAX NUMBER: 612-633-7507

CIRCLE 115 ON READER SERVICE CARD

Battery Life vs. Portability

The majority of the tested systems showed improved battery lives on the new ZDigit Rundown test, compared with their performance on our standard Battery Rundown test. The three-phase ZDigit test more closely approximates a real-world scenario by letting the systems exercise their disk and screen time-outs with great frequency. In order to simulate heavier usage, PC Magazine Labs also conducted the Battery Rundown test on this roundup's 70 battery-powered systems with all power-management features disabled. The 70 systems include 5 of the color notebooks reviewed in "Color Hits the Road." These 5 systems are set off in blue.

The electrical current that memory, CPU and chip set, disk, and video subsystems draw varies widely across the different system designs. Active-matrix displays are notoriously power-hungry. DRAM grids actively consume power, and when the memory size increases, so does the power drain. Hard disks differ in their power-management features by changing the amount of current they draw when active or idling; hard disks such as the Seagate ST-9000 series respond first to read requests from the on-board cache before spinning up an already spun-down disk. CPUs such as the AMD Am386SXL or Intel 386SL are capable of running at reduced speeds (or even at a full stop), consuming less power during periods of little CPU activity. PC Labs recognizes that physically measuring the current drawn by system components during testing is one way of approximating battery life, but the potential for damaging components is too great and we therefore avoid doing this.

Even with the additional power requirements, the IBM PS/2 Model CL57SX, NEC UltraLite SL/25C, and Toshiba T4400SXC are three active-matrix color notebooks that can also run on batteries. Unfortunately, the PS/2 Model CL57SX's ZDigit battery life of 1 hour 9 minutes is markedly lower than those of the other units tested, even though it uses a nickel hydride battery. The T4400SXC was the longest-lived active-matrix notebook; its ZDigit score of 4 hours 5 minutes is longer than those of many monochrome units. None of the active-matrix notebooks weigh under 7 pounds with their batteries installed.

Our review includes two passive-matrix color notebooks as well: the AST Premium Exec 386SX/25C and the Dell System 325NC. The latter really raised some eyebrows. With its 1.6-pound nickel hydride battery and some efficient power-conservation

Battery Life and Hours per Battery Pound

techniques, it lasted 4 hours 59 minutes, the eighth-best score.

Typically, an outstanding battery life requires larger and heavier batteries that add unwanted weight to the notebook, as is true of the first-place NCR Safari NSX/20, which lasted 4 hours 6 minutes but weighs 8.3 pounds. But the 5.7-pound 25-MHz Gateway Nomad 425DXL bucks the trend by providing an outstanding battery life of 4 hours 5 minutes on the Battery Rundown test. The best rundown times were shown by the 486DX Nomad 425DXL and the Am386SXL-based AST Premium Exec 386SX/25, which placed second and third, respectively. Weighing nearly a pound less than the Premium Exec 386SX/25, the 386SXL-based Gateway Nomad 325SXL logged an excellent time of 3 hours 34 minutes on the Battery Rundown test.

The CompuAdd Express 325NXL could not successfully execute the ZDigit test; this notebook showed an "Abort, error, retry" message when the ZDigit software attempted to write to the disk after the disk had spun down. The BCC SL007 and Compudyne 486DX/33 consistently failed to blank their screens at preset intervals during the ZDigit test, resulting in ZDigit timings that were worse than their Battery Rundown timings. The Tandy 4860 HD and Tandy 3830 SL incorporated automatic screen-blanking logic that negatively affected their ZDigit results because their screens are illuminated longer than the ZDigit 2-minute settings.

	Processor	ZDigit Rundown time (hours: minutes)	Rank	Battery Rundown time (hours: minutes)	Rank	Battery weight (pounds)	Rank	Battery life per pound (hours: minutes)	Rank	System weight (pounds)	Rank	Travel weight with adapter (pounds)	Rank
Altec 386SX/25 Notebook	386SXL/25	4 47	11	2 53	22	1 1	28	2 37	20	6 3	22	7 9	29
Aquiline NT33	386DX/33	1 51	65	1 37	63	2 2	67	12 44	70	8 5	69	10 3	69
AST Premium Exec 386SX/20	386SX/20	2 18	55	1 47	53	1 2	34	1 29	59	7 1	47	8 4	38
AST Premium Exec 386SX/25	Am386SXL/25	6 12	1	3 55	3	1 2	34	3 15	7	6 6	32	7 9	29
AST Premium Exec 386SX/25C	Am386SXL/25	2 31	49	2 12	42	0 9	17	2 26	26	7 5	56	8 7	44
Austin 386SX-25 Notebook	Am386SXL/25	4 48	9	2 56	20	1 1	28	2 40	19	6 8	36	8 7	44
BCC Avanti 025	Am386SXL/25	2 45	43	1 59	50	1 8	65	1 06	67	6 5	29	7 8	27
BCC SL007*	386SL/20	1 37	68	1 49	52	1 2	34	1 30	57	6 6	32	7 6	19
Blackship NB 320S	386SX/20	2 59	41	1 45	56	1 1	28	1 35	54	6 7	34	8 6	40
Blue Star 386DX/25 Notebook	Am386DXL/25	2 59	41	2 12	42	1 3	39	1 41	50	7 5	56	9 1	56
Blue Star 386SX/25 Notebook	386SX/25	4 21	14	3 03	17	1 0	19	3 03	12	7 9	63	9 4	60
Bondwell 386SL/F Notebook	386SL/25	2 03	64	1 37	63	0 8	9	2 01	36	5 5	6	7 4	17
Compaq LTE Lite/25	386SL/25	3 26	33	2 17	37	1 3	39	1 45	45	6 1	19	7 3	15
Compaq LTE Lite/20	386SL/20	3 26	33	2 16	39	1 3	39	1 44	48	6 1	19	7 3	15
Compaq LTE 386s/20	386SX/20	4 07	19	2 59	19	1 8	65	1 39	52	7 6	60	9 3	58
CompuAdd Express 325NXL*	386SX/25	5 28	4	1 31	67	0 5	1	3 02	13	5 0	3	6 6	3
Compudyne 386SXL/25	386SL/25	3 26	33	2 44	24	1 3	39	2 06	31	5 9	15	7 6	19
Compudyne 486DX/33*	486DX/33	2 05	61	2 12	42	1 3	39	1 41	50	5 9	15	7 6	19
Cumulus Express 386SX/20 Notebook	386SX/20	2 18	55	1 36	65	1 4	51	1 08	66	6 5	29	8	33
Dauphin 1050 Lapbook	386SX/20	2 16	60	1 42	60	1 2	34	1 25	63	7 6	60	9 3	58
DECpc 320P Notebook	386SX/20	3 26	33	2 09	45	0 8	9	2 41	18	6 4	25	7 7	24
Dell System NL25	386SL/25	3 26	33	2 26	35	1 3	39	1 52	42	6 3	22	7 7	24
Dell System 325N	386SL/25	5 12	7	3 02	18	1 6	62	1 53	39	6 4	25	7 6	19
Dell System 325NC	386SL/25	4 59	8	2 53	22	1 6	62	1 48	44	7 3	52	8 6	40
Epson NB-SL/20	386SL/20	3 29	32	2 33	31	0 7	2	3 38	4	7 0	43	8 2	35
Epson NB-SL/25	386SL/25	3 39	30	2 17	37	0 7	2	3 15	7	7 2	49	9	54
Everex Tempo Carrier 386SX/20	386SX/20	2 31	49	1 46	55	0 7	2	2 31	23	5 3	5	7	6
Gateway Nomad 325SXL	Am386SXL/25	5 41	2	3 34	8	1 3	39	2 44	17	5 7	9	7 1	7
Gateway Nomad 420SXL	486SX/20	4 34	12	3 41	5	1 3	39	2 50	16	5 8	13	7 2	13
Gateway Nomad 425DXL	486DX/25	5 30	3	4 05	2	1 3	39	3 08	10	5 7	9	7 2	13
IBM PS/2 Model CL57SX	386SX/20	1 09	70	12 50	70	0 8	9	1 02	69	11 4	70	13.7	70
Identity 386SX/20 Notebook	386SX/20	2 18	55	1 45	56	1 1	28	1 35	54	6 4	25	7 7	24
Insight 386-25SXL Notebook	Am386SXL/25	2 18	55	1 45	56	0 7	2	2 30	24	5 7	9	7 1	7
Intelec Halikan 386SX/20	386SX/20	2 30	52	1 53	51	1 3	39	1 26	62	6 5	29	8 3	36
KRIS Master 386SX/25	Am386SXL/25	3 12	38	2 41	25	1 4	51	1 55	38	6 7	34	8 5	39
Matrix 386SX/20 Notebook	386SX/20	4 20	15	3 06	16	1 4	51	2 12	30	7 3	52	8 9	53
Micro Express NB913 Notebook PC	386SX/20	4 20	15	3 20	12	1 0	19	3 20	6	7 9	63	9 5	64
Micro Express NB925	386SX/25	4 06	21	2 56	20	1 0	19	2 56	14	8 0	68	9 5	64
Micro Express NB2500 Notebook	Am386DXL/25	2 31	49	2 28	33	1 3	39	1 53	39	7 4	55	9 1	56
Mitsuba Ninja 386SX/20	386SX/20	4 07	19	2 02	47	1 4	51	1 27	60	7 3	52	9	54
NBCC 386SL/20	386SL/20	2 44	47	2 02	47	0 8	9	2 32	22	7 1	47	8 8	48
NCR Safari NSX/20	386SX/20	5 15	5	4 06	1	0 8	9	5 07	1	7 2	49	8 3	36
NCR System 3170	386SL/25	1 50	66	1 38	61	0 8	9	2 02	34	5 2	4	7 6	19
NEC UltraLite SL/20	386SL/20	3 45	27	2 05	46	1 0	19	2 05	32	6 4	25	7 9	29
NEC UltraLite SL/20P	386SL/20	2 45	43	1 38	61	1 0	19	1 38	53	6 9	38	7 9	29
NEC UltraLite SL/25C	386SL/25	2 17	59	1 11	69	1 0	19	1 11	65	7 2	49	8 8	48
NEC UltraLite III	386SX/20	1 50	66	1 45	56	0 7	2	2 30	24	4 7	1	5 8	1
MicroStar NoteStar NP-913 386SX/20	386SX/20	4 34	12	3 34	8	1 0	19	3 34	5	7 9	63	10 2	67
MicroStar NoteStar NP-925 386SX/25	386SX/25	4 48	9	3 09	14	1 0	19	3 09	9	7 9	63	10 2	67
Olivetti Notebook S20	Am386SXL/20	2 45	43	2 34	28	1 7	64	1 30	57	7 0	43	8 6	40
Packard Bell 386SX/20 Notebook	386SX/20	3 40	28	2 34	28	1 4	51	1 50	43	7 0	43	8 6	40
PC Brand 386SX-25 Notebook	386SX/25	2 45	43	2 28	33	1 4	51	1 45	45	6 9	38	8 8	48
Poly Notebook 320T	386SX/20	3 52	25	3 07	15	1 4	51	2 13	28	6 9	38	8 7	44
Positive PC320ND	386SX/20	2 32	48	2 02	47	1 4	51	1 27	60	6 9	38	8 7	44
Proteus 386/20NB	386SX/20	1 24	69	1 14	68	0 7	2	1 45	45	6 0	18	7 1	7
Sanyo MBC-18NB6H	386SX/20	3 39	30	2 15	40	1 1	28	2 02	34	6 9	38	8 8	48
Sharp PC-6781 Notebook	386SL/20	2 04	62	1 47	53	0 8	9	2 13	28	4 9	2	6 2	2
Swan 386SX/20 Notebook	386SX/20	3 52	25	2 39	26	1 4	51	1 53	39	7 0	43	8 8	48
Swan 386SX/25 Notebook	386SX/25	2 04	62	1 36	65	0 8	9	2 00	37	5 8	13	6 9	4
Tandy 3830 SL*	386SL/25	2 30	52	2 39	26	0 9	17	2 56	14	5 9	15	7 1	7
Tandy 4860 HD*	486DX/33	2 23	54	2 15	40	1 3	39	1 43	49	5 6	7	7 5	18
Tartan NP-925	Am386SXL/25	4 20	15	3 48	4	1 0	19	3 48	2	7 9	63	9 4	60
Tenex NB25SX	Am386SXL/25	5 15	5	3 25	10	1 1	28	3 06	11	6 3	22	8	33
TI TravelMate 3000 WinSX	386SX/20	3 12	38	2 29	32	1 2	34	2 04	33	6 1	19	7 8	27
Toshiba T2200SX	386SX/20	4 06	21	3 22	11	1 5	61	2 14	27	5 6	7	6 9	4
Toshiba T3300SL	386SL/25	3 40	28	3 37	7	1 4	51	2 35	21	5 7	9	7 1	7
Toshiba T4400SX (LCD)	486SX/25	4 19	18	3 40	6	2 3	68	1 35	54	7 5	56	9 4	60
Toshiba T4400SX (plasma)	486SX/25	3 55	24	3 12	13	2 3	68	1 23	64	7 5	56	9 4	60
Toshiba T4400SXC	486SX/25	4:05	23	2.26	35	2 3	68	1:03	68	7.8	62	9 5	64
Transource Version 386SX/20	386SX/20	3 12	38	2 34	28	0 7	2	3 40	3	6 8	36	7 1	7

* This portable was able to run our ZDigit Rundown ttest, but with incompatibilities that hindered its performance to some extent.

EDITORS' CHOICE

- **Dell System 325N**
- **Toshiba T3300SL**

The 65 386- and 486-based monochrome notebooks in this roundup are the strongest we've seen so far, but this review also drives home the fact that the perfect notebook PC still isn't here. Even the best and brightest systems have flaws or lack desired features. Still, two notebooks distinguish themselves as excellent all-around performers: the Dell System 325N and Toshiba T3300SL. We also awarded honorable mentions to seven systems: the Compaq LTE Lite/25, CompuAdd Express 325NXL, Compudyne 486DX/33, Compudyne 386SXL/25, Gateway Nomad 425DXL, Toshiba T4400SX, and Toshiba T2200SX.

The $2,698 Dell System 325N (with 4MB of RAM and a 60MB Conner hard disk) combines strong, cached 386SL/25 performance with solid graphics capability—a Graphics Winmark score of 1.3 million. This road warrior also has the right features for long trips: a worst-case battery life of 3 hours 2 minutes, a 120MB hard disk option, 9,600-bps data/fax modem, and travel weight of 7.6 pounds.

Dell has put together a host of useful functions and power-conservation options in its System 325N that should make any user happy. We just wish the company had labelled them on its keyboard (as it did for the System 325N's lesser brother, the Dell System NL25). To achieve its small 2- by 11- by 8.5-inch form factor, Dell compressed the size and spacing of the keyboard, so you may need a little time to adjust, but we found the compromise to be barely noticeable.

The $3,999 T3300SL (with 2MB of RAM and an 80MB JVC hard disk) represents the cutting edge of technology combined with usability. Function and form blend nicely in this 5.7-pound 386SL/25. Its cached processor and Western Digital video chip set match the performance of the System 325N, its battery life of 3 hours 37 minutes ranks in the top ten percent of all notebooks, and its 120MB hard disk option would please many desktop PC users.

One of the smallest AC power adapters around brings the travel weight of the T3300SL to just 7.1 pounds—a weight that would overburden few, and that remains beyond the reach of much of the competition. A bright, 9.5-inch backlit Toshiba display and a wonderful 82-key keyboard round off an ergonomically pleasing system. (All the keys—including the 12 function keys—are full-size, and the cursor keys are in the desired inverted-T layout, with dedicated Home, End, PgUp, and PgDn keys.)

The T3300SL also features Toshiba's AutoResume, a deep-sleep state to protect the contents of RAM for as much as a week. However, its host of other battery-conservation features do not pop up graphically over Windows.

Other drawbacks to be aware of include limited modem options and Toshiba's lack of support for the faster Enhanced Parallel Port option that Intel has built into its 386SL CPU. Since the T3300SL lacks a dedicated internal modem slot (Toshiba opted instead for a proprietary PCMCIA-like option slot), the current modem choices are limited by today's technology to 2,400-bps speeds.

HONORABLE MENTIONS

Two machines stand out for their exceptional bang-for-the-buck performance: the Compudyne 486DX/33 and the Gateway Nomad 425DXL. All three models lacked a processor RAM cache but placed solidly midrange on our processor and memory tests. The disk test yielded moderate rankings for both the 19-millisecond Conner CP-2084 hard disks in the Altec and Tenex and the 19-ms Conner CP-2064 in the Austin. All three turned in average video and Graphics Winmark scores as well. Put succinctly, these three are average-performing notebooks.

The charcoal-gray cases and lighter-gray keys add little brightness to these identical systems. Green LEDs above the top row of keys on the left indicate power on, low battery, and the lock keys' status. The three share the preferable inverted-T cursor-key layout, but the lack of dedi-

FACT FILE

Altec 386SX/25 Notebook

Altec Technology Corp., 18555 E. Gale Ave., Industry, CA 91748; 800-255-9971, 818-912-8688; fax, 818-912-8048

List price (tested configuration): $2,345.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case.
Options: 1MB RAM upgrade, $65; 2MB RAM upgrade, $130; 4MB RAM upgrade, $260; math coprocessor, $150; numeric keypad, $65; extra battery, $99; 5-hour battery pack, $210; car battery adapter, $90; 2,400-bps/4,800-bps fax modem, $125.

485 ON READER SERVICE CARD

FACT FILE

Austin 386SX-25 Notebook

Austin Computer Systems Inc., 10300 Metric Blvd., Austin, TX 78758; 800-752-1577, 512-339-3500; fax, 512-454-1357

List price (tested configuration): $2,195.
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, carrying case.
Options: 1MB RAM upgrade, $99; 2MB RAM upgrade, $199; 4MB RAM upgrade, $469; math coprocessor, $159; numeric keypad, $99; internal battery, $99; external, rechargeable battery, $199; car battery adapter, $109; 2,400-bps/4,800-bps fax modem, $199; external 2,400-bps pocket modem, $129; external 2,400-bps fax modem, $339.

490 ON READER SERVICE CARD

Compudyne Products sells its 33-MHz 486 notebook with a 130MB hard disk for $3,206. With a Graphics Winmark score of 2.3 million, the Compudyne 486DX/33 gives you desktop performance and storage in 7.6 pounds of travel weight. An integrated trackball wasn't the easiest to use but is better than none. Windows users can throw away their clip-on pointing devices. Drawbacks include general dissatisfaction with the 84-key keyboard, due to its very short key travel. The awkward power-management features made the Compudyne 486DX/33 difficult to customize, which likely contributed to the system's low battery life of 2 hours 12 minutes. This score might be competent for a 486/33, but serious travelers will demand 3 hours.

Gateway 2000's three TI-designed systems (386SX/25, 486SX/20, and 486DX/25) all provide an excellent combination of performance and long battery life at highly competitive prices. Most noticeable is the $3,495 Gateway 425DXL, which includes a 25-MHz 486DX, 120MB Seagate hard disk, battery life of 3 hours 34 minutes, and Graphics Winmark score of 2 million in its 7.2-pound travel weight. We were dissatisfied by the unit's mediocre keyboard and distressed by the amount that its case flexes, but we do not have enough experience with the system to question its reliability. The addition of a stronger case would certainly make us feel better.

LOW-COST FAVORITES

For those looking for a good value at the $2,000 price point, two systems deserve serious consideration: the honorable-mention CompuAdd Express 325NXL ($2,095) and the Compudyne 386SXL/25 ($1,806). The 325NXL includes a fax modem, a built-in trackball, and an excellent keyboard (eight dedicated cursor keys in an inverted-T layout, and separate Home, End, PgUp, and PgDn keys). Its battery life of 1 hour 31 minutes cost it an Editors' Choice, but the half-pound battery was the smallest in the roundup and helps account for the system's remarkably low 5-pound weight (6.6 with the adapter and cables), the third-lightest of the systems reviewed here.

The Compudyne 386SXL/25 includes 6MB of RAM, a 60MB Conner hard disk, and Microsoft Windows 3.1 in its $1,806 price tag. Its 7.9-pounds of travel weight also features a trackball integrated into the notebook, and its battery life of 2 hours 44 minutes should not disappoint you. With the same case as its 486 cousin, the Compudyne 386SXL/25 shares the same drawbacks, including an unfriendly keyboard and convoluted power-management features.

FOR THE POWER-HUNGRY

Toshiba's 25-MHz 486SX, the Toshiba T4400SX, also warrants an honorable mention. Lesser brother to the Toshiba T4400SXC color notebook, it offers all the features except that bright active-matrix color display, for $2,400 less. We preferred the LCD version ($5,299) over the orange-plasma system that cost $300 more—$300 that could go toward the T4400SXC. While the plasma unit did not ghost under Windows, it was limited to 16 gray shades. The 64-gray-shade LCD provides easier viewing. Both units had desktop graphics performance, including a Graphics Winmark score of 2.2 million. Other niceties include a no-compromise keyboard, a 9,600-bps MegaHertz modem, and a 120MB hard disk.

The T4400SX features a superior battery life of 3 hours 37 minutes. Its 2.3-pound battery obviously has as much to do with this as it does with its 9.5-pound travel weight. Although it won an Editors' Choice in our last roundup, we feel that its bigger size and weight are more easily justified in a color notebook. For this reason, we have awarded the color T4400SXC Editors' Choice, while recognizing its monochrome versions as excellent systems that merit honorable mentions.

Two other former Editors' Choices that we feel warrant only an honorable mention are the $4,199 Compaq LTE Lite/25 and the $3,978 Toshiba T2200SX. The LTE Lite/25's positive features include Compaq-quality construction, excellent security features, a 9,600-bps modem, good performance under Windows, a handy setup utility that pops up over Windows, and a hibernation feature that writes the contents of memory to the hard disk so no data is lost when the battery fails. Among the negatives that cost the LTE Lite/25 an Editors' Choice are a keyboard that most of our testers found stiff. Everyone agreed that the Chicklet-size (half-height and -width) function, Home, End, PgUp, and PgDn keys were hard to use. The LTE Lite/25's battery life was also worse than the older, Compaq LTE 386s/20, since Compaq shaved half a pound off the battery to obtain its 7.3-pound travel weight.

The Toshiba T2200SX remains a capable performer and solid choice, but it is also last year's technology. An excellent keyboard, good screen, and battery life of 3 hours 22 minutes all speak in its favor, but its uncached 386SX/20 performance and 80MB hard disk have been superseded by the T3300SL.

For those interested in great battery performance, the AST Premium Exec 386SX/25 is right there among the leaders, but it's also a slightly older technology. The NCR Safari NSX/20 also has a great battery life, as well as a host of telecommunications options, but it needs two batteries to do it.

Notebooks from BCC and Sharp are among the leaders in ergonomic design. The 4.9-pound Sharp PC-6781 Notebook includes an 80MB hard disk, a 3.5-inch floppy disk drive, and an integrated trackball. Its 6.2-pound travel weight was bested only by the NEC UltraLite III, whose 4.8- to 5.9-pound weight does not include a floppy disk drive. Drawbacks of the PC-6781 include a $3,898 price and a battery life of only 1 hour 47 minutes. BCC offers some of the best multilayered security and ergonomic designs in its BCC Avanti 025 and BCC SL007 notebooks, but like Sharp, high price and poor battery performance diminish its value.

cated Home, End, PgUp, and PgDn keys made cursor manipulation awkward.

All three systems support a math coprocessor and an internal 2,400/4,800-bps send-fax modem. Tenex goes one better than the others by including the modem as part of its $2,095 price; it is also the only company that offers on-site service ($69.95 per year from TRW), though all three notebooks have one-year warranties on parts and labor and offer toll-free technical support. Both Tenex and Altec mirror-ship within a three-day response time; Austin pays shipping within 30 days after purchase, with a one-week response time.—*Camille N. Cline*

Notebook PCs: Recent Reviews

Model	*PC Magazine* review (issue date and page)
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Altec 386SX/20 NB	121
Blackship 386SX/20NB	128
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MicroStar NoteStar NP-902	168
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Many of the 27 386SX notebooks *PC Magazine* reviewed in the August 1991 issue are no longer available

■—Editors' Choice

FACT FILE

Tenex NB25SX

Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545-7481; 800-776-6781, 219-259-7051; fax, 219-255-1778

List price (tested configuration): $2,095.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, 2,400-bps/4,800-bps fax modem, carrying case.
Options: 1MB RAM upgrade, $95.99, 2MB RAM upgrade, $160; 4MB RAM upgrade, $295; math coprocessor, $94.95; numeric keypad, $79.95; extra battery, $60; external 5-hour battery, $140; car battery adapter, $99.95; hand-scanner adapter, $129.95; mini-SCSI network adapter, $179.95; Thumbelina mouse, $79.95

491 ON READER SERVICE CARD

Aquiline Inc.

Aquiline NT33

A little bigger and heavier than a standard notebook, the solid, sturdy, monochrome Aquiline NT33 is nonetheless packed with power.

Weighing 8.5 pounds with its nickel cadmium battery, and measuring 2.3 by 11 by 10 inches, our $2,595 test unit was the only 33-MHz notebook reviewed in this issue. It had an Intel 386DX processor, 4MB of RAM (expandable to 16MB), 32K of four-way set-associative RAM cache managed by a Chips & Technologies F82C351 controller, a 170MB Conner hard disk with a 32K buffer, a 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.0, and a carrying case. The 8.5-inch diagonal triple-supertwist backlit LCD, made by Sharp, displays 32 shades

SUITABILITY TO TASK

Aquiline NT33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

of gray and is controlled by a Cirrus Logic GD610/620 chip set.

The Aquiline NT33 proved to be a strong, consistent performer in the 386DX category. Credit for fast scores on memory-intensive tasks is most likely due to the 33-MHz processor and its powerful cache. However, the unit also placed first on our DOS-based video and Graphics Winmark tests. The battery life was disappointing, though: 1 hour 37 minutes on our Battery Rundown test and little better on our ZDigit Rundown test. Instead of being inside the unit, the battery screws onto the back, adding 1.5 inches to the notebook's size.

A driver loaded into CONFIG.SYS lets you invoke power-conservation features; these include a display saver, hard disk power saver, and CPU slowdown. Via hockey combinations, this driver lets you access a pop-up utility to change power-conservation settings and such system features as reverse video, automapping, and display fonts. Another driver performs similar functions under Microsoft Windows. Alternatively, you can control many of these features through the clearly labeled function keys on the keyboard. The keyboard is blessed with a clicky, featherlike feel and has full-

FACT FILE

Aquiline NT33

Aquiline Inc., 449 Main St., Bennington, VT 05201; 800-370-3322, 802-442-1526; fax, 802-442-8661

List price (tested configuration): $2,595
Tested Configuration: 4MB RAM, 170MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, carrying case
Options: 1MB RAM upgrade, $49; upgrade to 240MB hard disk, $200; external floppy disk drive, $329; math coprocessor, $195, external keyboard, $50, extra battery, $149; battery charger, $125; car battery adapter, $95, 9,600-bps MNP 5 fax modem, $195

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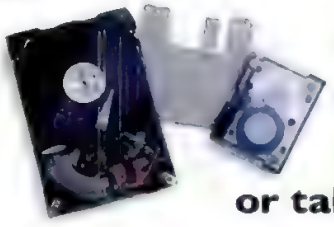

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CIRCLE 390 ON READER SERVICE CARD

height function keys; cursor keys in an inverted-T layout; and dedicated Home, End, PgUp, and PgDn keys.

Aquiline offers an extra battery, a docking station, a car battery adapter, a battery charger, and a 2,400/9,600-bps send/receive MNP 5 fax modem. The warranty is for one year on parts and labor; an extended warranty costs 10 percent of the purchase price. Aquiline's swap program lets you receive a new system within 24 hours, wherever you are; this service is included in the warranty. Both the service call and technical support are toll-free. *—Margaret A. Piemonte*

AST Reasearch Inc.

AST Premium Exec 386SX/25
AST Premium Exec 386SX/20

The $3,295, monochrome AST Premium Exec 386SX/25 and AST Premium Exec 386SX/20 are identical in cost, weight, dimensions, and looks, but they differ in a few important respects. The 25-MHz AST model uses an Am386SXL processor, while the 20-MHz model uses an Intel 386SX. Neither ventures a breakthrough in weight, battery life, performance, or design, but both units are sturdy and reliable notebooks that have staked out a conservative foothold at the high end of the market. If you don't mind slinging an 8-pound travel package over your shoulder and don't want to venture into the high-powered, high-price bracket, then the AST Premium Exec 386SX/25 will do the job.

Each model weighs 7 pounds and is a bit bulky at 2.5 by 11.5 by 9 inches. Like the AST Premium Exec 386SX/25C, the color version reviewed in this issue's color section, the Premium Exec 386SX/25 offers the same intelligent power usage as the Am386SXL/25 processor. This notebook comes with 4MB of RAM (8MB maximum), an 80MB JVC hard disk, a 1.44MB-inch floppy disk drive, DOS 5.0, and Microsoft Windows 3.1. Its backlit 8.5-inch LCD, made by Epson, shows 16 crisp shades of gray at 640-by-480 or 32 shades at 300-by-320.

The Premium Exec 386SX/25 placed slightly lower than its color counterpart on our memory tests but was still average for its class in terms of processor, memory, and disk performance. Its Cirrus Logic CL-320C video chip set, relying on 70-nanosecond video RAM, yielded average performance on our video test but turned in below average scores on our Graphics Winmark test. On all measures except battery life, where the AST Premium Exec 386SX/25 lasted about 5.5 hours, it couldn't perform on a par with the Premium Exec 386SX/25C.

SUITABILITY TO TASK

AST Premium Exec 386SX/25	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

AST Premium Exec 386SX/20	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Based on an Intel processor, the AST Premium Exec 386SX/20 yielded average performance as well. The componentry of the two systems was similar, except that the 386SX/20 had an 80MB Toshiba hard disk, while the Premium Exec 386SX/25 came with a JVC unit. Though its Cirrus Logic GD610/620 video subsystem was also an average performer, it beat half the competition. Lack of a processor RAM cache kept both AST models from scoring as dramatically on the processor test as did the cached units from Compaq and NEC.

With AST's standard hard-disk and screen time-outs enabled, the Premium Exec 386SX/20 lasted 2 hours 18 minutes on its nickel cadmium battery, compared with 70 minutes for the IBM PS/2 Model CL57SX and more than 5 hours for the NCR Safari NSX/20. Another intelligent power-conservation feature is the deep sleep mode: Close the case and it dozes off; open it and you're instantly back at the same spot.

AST offers plenty of options for both notebooks, including a 9,600-bps data fax modem ($499) and a send-only unit ($349), 4MB of RAM ($999), a 120MB hard disk ($1,249), and a coprocessor slot. Both systems come with AST's one-year warranty on parts and labor, toll-free technical support, BBS support, and help by fax. For $45 a year, you subscribe to Execare, which guarantees 24-hour repair or replacement.*—Carol Levin*

FACT FILE

AST Premium Exec 386SX/25

AST Premium Exec 386SX/20

List price (tested configuration): $3,295 each

Tested Configuration: 4MB RAM, 80MB JVC hard disk (386SX/25), 80MB Toshiba hard disk (386SX/20), 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case

Options: 1MB RAM upgrade, $169; 4MB RAM upgrade, $599; upgrade to 120MB hard disk, $1,249; numeric keypad, $119; extra battery, $99; battery charger, $99; trickle charger, $29; car battery adapter, $99; second serial adapter, $99; 2,400-bps modem, $249; 9,600-bps fax modem, $499; 9,600-bps send-fax modem, $349; nylon carrying case, $99; leather carrying case, $229.

AST Research Inc., 16215 Alton Pkwy., P.O. Box 19658, Irvine, CA 92713; 800-876-4278, 714-727-4141; fax, 714-727-9355

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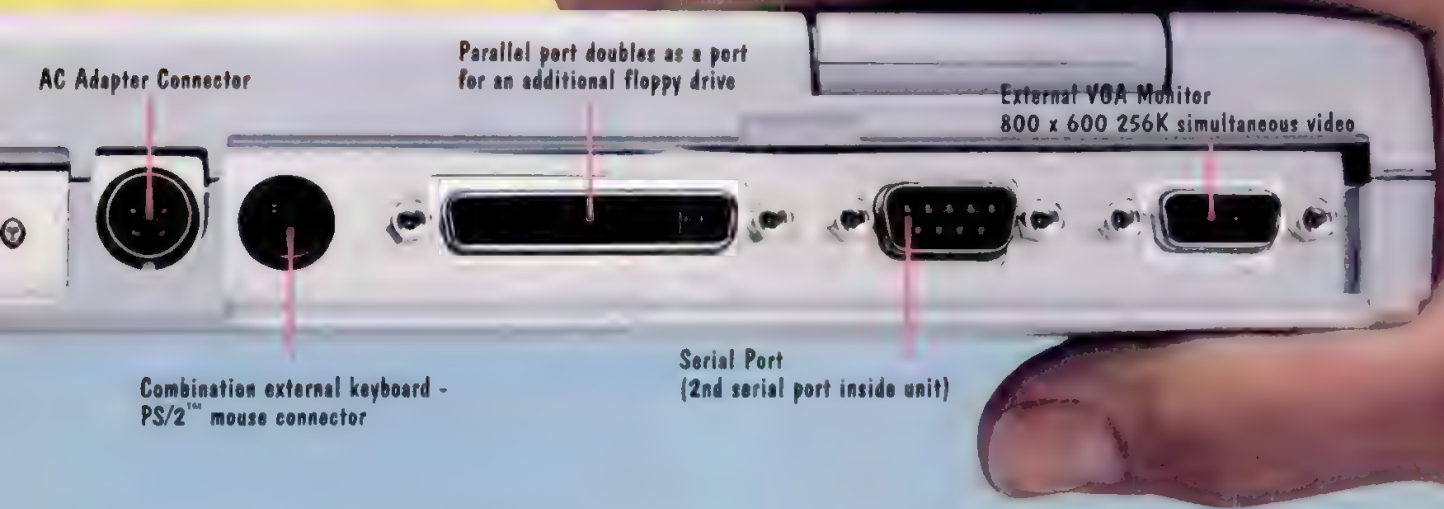

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Notebook	CPU	RAM	HD	Battery Life	Price
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386SL/25	Intel 80386SL-25 MHz 64 K CPU cache Advanced SL power mgm t Optional 80387SX co processor	2 standard 4 & 6 options	80	3+	$1,999 $74/mo*
486SX/25	Intel 80486SX 25 MHz Built in 8K CPU cache	4 standard 8 & 20 options	80	2.5+	$2,499 $93/mo*
486DX/33	Intel 80486DX-33 MHz Built-in 8K CPU cache	as above	130	2.5+	$2,999 $111/mo*

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BCC

BCC Avanti 025
BCC SL007

Several ergonomically designed features make the BCC Avanti 025 stand out. The eye-catching screen pivots when you open the notebook, an advantage on airplanes and in other cramped places. The keyboard, set on a 5-degree slope to facilitate typing, is another convenience. Such good design elements, combined with competent performance, make the Avanti 025 and its BCC SL007 counterpart stand out from the rest. Unfortunately, so do their prices.

The Avanti 025 is based on a 25-MHz Am386SXL. Its $3,699 retail price includes 4MB of RAM, a 17-millisecond 130MB Toshiba hard disk with a 32K read-ahead cache, a 1.44MB floppy disk drive, and a coprocessor slot. DOS 5.0 and Microsoft Windows 3.0 are preinstalled. WinFax and Terminal Plus control the built-in 9,600-bps fax modem. Ports include parallel, serial, VGA, and a built-in bus-mouse port (for a mouse that plugs into a bus port rather than a serial port).

The notebook comes in a scratch-resistant black case that has a pleasant sheen and a soft, rugged feel. It measures 3 by 11.5 by 9 inches and weighs 6.5 pounds with its nickel cadmium battery. Minimum memory is 2MB, expandable to 8MB in 2MB increments that cost $129 each. The 10-inch backlit triple-twist LCD, made by Sharp, is controlled by a Western Digital chip set that provides 640-by-480 resolution.

With 80-nanosecond RAM and no RAM cache, the Avanti 025 performed in the midrange on our processor and memory benchmark tests. But its Western Digital chip set yielded above-average performance in both our video and Graphics Winmark tests.

SUITABILITY TO TASK

BCC Avanti 025

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

BCC SL007

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	○	○	○

The keyboard feels a bit mushy but has good-sized keys. Key layout is another issue. The cursor keys are not laid out in an inverted T, a surprising inconvenience in a generally well-designed system. Furthermore, you need a function key to access Home, End, PgUp, and PgDn. One other design flaw of real consequence involves the notebook's DC power-in connector and mouse port. Both are PS/2 mouse-type connectors; you can force the power connector into the mouse port without much effort—resulting in permanent damage to the system's keyboard controller circuitry.

BCC SL007

Anticipating a concern for data security, BCC (Beaver Computer Corp.) has designed the SL007's hard disk to handle encryption via a DES (data encryption standard) coprocessor; you need a password to gain access. But you pay a premium for hardware encryption, so it's a good value only if you need it.

For the $5,995 list price (the dealer price could drop as low as $3,800), you get a 20-MHz Intel 386SL processor with 4MB of RAM; both a 64K primary SRAM cache and a 6K processor RAM cache are installed. You can expand the system memory from 4MB to 8MB in 2MB increments. Our test unit had an 85MB Toshiba hard disk.

Other features, including the problem with the mouse port and the AC power connector, are similar to those of the Avanti 025. Though the SL007 is smaller (at 2.5 by 11 by 8.5 inches) and lighter (at 6.6 pounds), the color and scratch-resistant finish are the same; so is the floppy disk drive, modem, and complement of ports. Like the Avanti 025, the SL007 has the pivoting screen—a BCC trademark. The 10-inch-diagonal VGA screen, manufactured by Sharp, is directed by a Western Digital WD90C20 video chip set. Screen contrast is fair to middling; oddly, a checkerboard pattern appeared in the background after recovery from screen blanking. The checkerboard fades quickly when the nickel cadmium battery is fully charged, but as it runs down, the pattern becomes more pronounced and recovery is slower. But the keyboard has a solid feel, and the tipped-L configuration of the cursor keys is acceptable.

FACT FILE

BCC Avanti 025

List price (tested configuration): $3,699

Tested Configuration: 4MB RAM, 130MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, WinFax 2.0, Terminal Plus, Magic Cursor!, 9,600-bps fax modem, carrying case

Options: 2MB RAM upgrade, $129.95; upgrade to 130MB hard disk, $500; extra battery, $129.95; car battery adapter (BCC SL007), $49.95

BCC SL007

List price (tested configuration): $5,995

Tested Configuration: 4MB RAM, 85MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 9,600-bps fax modem, carrying case.

Options: same as BCC Avanti 025

BCC, 1610 Crane Ct., San Jose, CA 95112; 800-827-4222, 408-944-9000; fax, 408-944-0657

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CIRCLE 323 ON READER SERVICE CARD

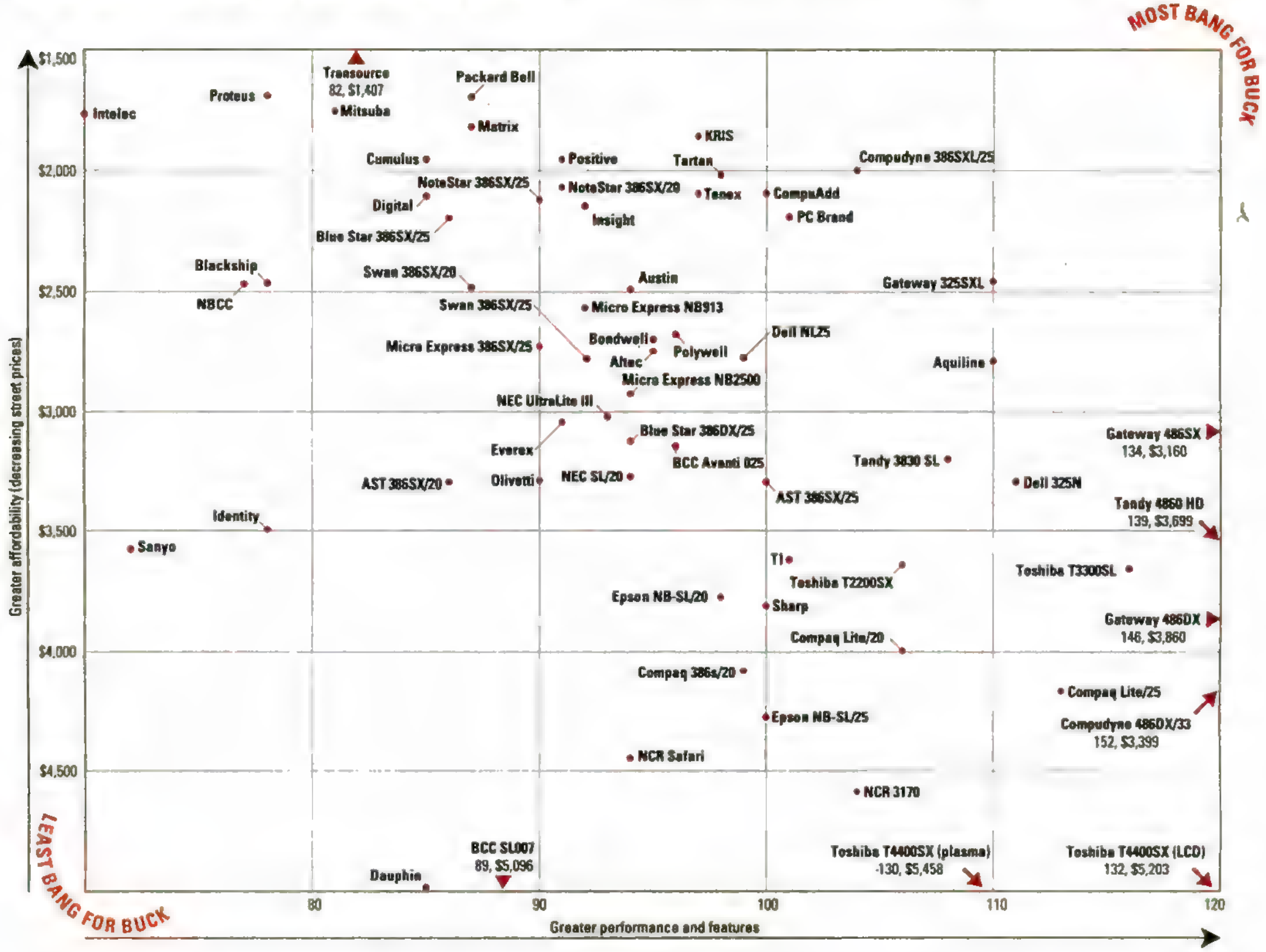
Price/Performance Index: *Portable PCs*

Of the monochrome notebooks we reviewed, the Compudyne 486DX/33 and Gateway 486DX machines placed well out in front on the performance scale. Had this been a review of only 486 machines, the Compudyne 486DX/33 would have been even further up and to the right; competing with 386SX/20 machines, it still has an excellent position. The Tandy 4860 HD and Gateway 486SX are next in line, with respectable scores.

The Toshiba T4400SX notebooks offer considerable performance bang, but their hefty price tags dragged them down. The Compudyne 486DX/33's low price and its full 33-MHz DX performance account for its position, while marvelous battery times, fast memory and video scores, and relatively low prices contribute to the two Gateway 486s' strong bang for the buck. The Tandy 4860 HD almost mirrored the Compudyne 486DX/33's performance but was more expensive and lacked some features, while the Toshiba T3300SL also performed well but suffered from the same tendency toward overpricing as its T4400SX brethren.

Unlike the cutting-edge color machines, almost none of the monochrome units placed in the favored, upper-right corner representing the best bang for the buck.

The chart below rates the 64 monochrome portables on more than 20 features and performance items and compares these ratings with each computer's selling price. The *x*-axis measures increasing performance. The *y*-axis measures increasing affordability (lower price). We did not include a separate listing for the NEC UltraLite SL/20P, since it was nearly identical in features to the NEC UltraLite SL/20, although its $1,100 price premium means less bang for your buck.



THE DATA POINTS

The following elements make up the performance/features score: benchmark test results (35 percent); travel weight, size, and battery life (33 percent); memory and disk space (16 percent); screen size, modem, Super VGA output, extra cursor keys, I/O ports, power-conservation features, free software, an extended warranty, and on-site service availability (16 percent).

The selling price, charted on the *y*-axis, includes the system price and the price of the most useful modem. We discounted laptops available through dealers by 15 percent to approximate street prices. We did not discount mail-order systems.

To view the data we used to create this chart, look for 14MBANG.WK1 in the Software Library of PC MagNet's Editorial Forum.

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intel inside

With its memory and processor caches, the SL007 won above-average scores on our processor and memory tests. The 19-millisecond 85MB hard disk performed poorly, but the optional 17-ms 130MB hard disk with a 32K buffer is faster. Its video speed was average. The SL007 lasted 1 hour 49 minutes on our Battery Rundown test and 2 hours 45 minutes on our ZDigit Rundown test.

BCC makes available a wide range of options and offers a one-year parts-and-labor warranty. You must ship the unit back to the manufacturer for repairs, but BCC pays the shipping charges. If the repairs can be done in-house, a 72-hour turnaround time is guaranteed. Free technical support is available via an 800 line. *—Sheryl Canter*

Blackship NB 320S

Blackship Computer Systems Inc.

Blackship NB 320S

The Blackship NB 320S is Blackship Computer Systems' OEM version of the USA FlexNote 20, which garnered an Editors' Choice in our January 28, 1992, laptop review. The FlexNote packed goodies like DOS 5.0, Microsoft Windows 3.0, and a Logitech mouse in a less-than-ideal but inexpensive machine. At $2,245, the Blackship sells for $250 more. While it includes 20MB more hard disk space and an additional 2MB of RAM, it leaves out the extras that made the FlexNote 20 attractive. And unfortunately, the machine is still less than ideal. If the keyboard doesn't drive you crazy, you might like the Blackship NB 320S, but there are better options.

The sturdy black box weighs 6.8 pounds and measures 2.5 by 11 by 8.5 inches. Its Intel 386SX/20 processor is uncached, and the system accepts up to 5MB of RAM in 1MB increments. The 80MB Conner hard disk added $150 to the price, but you can order a 60MB unit (options extend up to 120MB). The 8.5-inch Sanyo screen is coupled with a Cirrus Logic GD-610/620 chip set, Cirrus BIOS, and 256K of video RAM. An internal 2,400-bps/9,600-bps send/receive fax/data modem lets you save the single serial port for better uses, but it will set you back $220. The single parallel port is accompanied by a separate keyboard port.

SUITABILITY TO TASK

Blackship NB 320S

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

The Blackship is a mainstream machine, doing an average job on the memory test, slightly above average on the disk test, and slightly below average on the video and Graphics Winmark test. The nickel cadmium battery lasted 1 hour 45 minutes on our Battery Rundown test, although power-conservation features stretched that to 3 hours on our ZDigit Rundown test. The unit includes a standby mode, and a trickle-charge feature encourages users to leave the machine plugged in when not in transit.

The Blackship has its ergonomic drawbacks. The L-shaped arrow block (which doubles as Home, End, PgUp, and PgDn keys) will annoy typists used to standard keyboards. The reverse-screen option is missing; password protect and memory count cannot be disabled. Worse, the power-on push button is located outside the cover in a spot that's easy to hit even when you're not aiming. Without an alarm to alert you when the machine is on and the cover closed, you may have a lot of unexpectedly drained batteries.

Along with a 30-day money-back guarantee, Blackship offers a one-year warranty on parts and labor. Though DOS 5.0 is bundled, the unit we saw had neither Windows nor a mouse—two of the extras that made the FlexNote 20 worth the trouble. Service work is done at the factory; technical support is available via an 800 number. *—Angela Gunn*

FACT FILE

Blackship NB 320S

Blackship Computer Systems Inc., 2031 O'Toole Ave., San Jose, CA 95131; 800-531-7447, 408-432-7500; fax, 408-432-1443

List price (tested configuration): $2,245
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, carrying case
Options: 1MB upgrade, $50, math coprocessor, $175; extra battery, $75, 9,600-bps data/fax modem, $210

486 ON READER SERVICE CARD

Blue Star Computers Inc.

Blue Star 386DX/25 Notebook

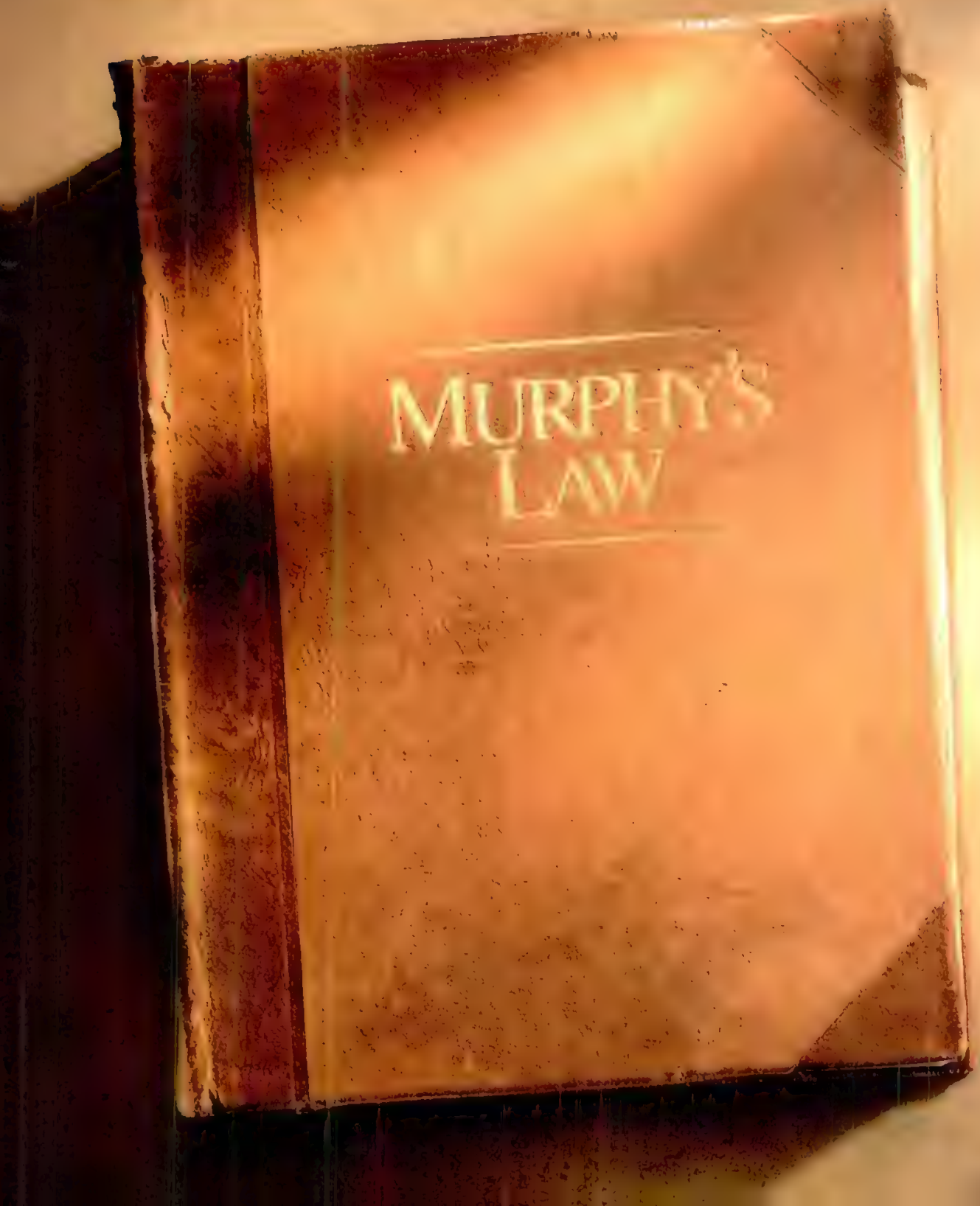
Micro Express

Micro Express NB2500 Notebook

The Micro Express NB2500 Notebook and the identical Blue Star 386DX/25 Notebook are the only ones using the 25-MHz Am386DXL processor in this roundup. Each has 4MB of RAM; 128K of direct-mapped, write-back RAM cache governed by a SIS controller; a 124MB Toshiba hard disk; a front-accessible

Blue Star 386DX/25 Notebook, Micro Express NB2500 Notebook

DELL INTRODUCES A CONCEPT SO REVOLUTIONARY, IT BREAKS EVERY LAW IN THE BOOK.



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That's a law so fundamental, it's practically built into every brand of computers on earth. Fortunately, you've told us how to make it better.

In the course of millions of conversations with our customers, we discovered what bothers you about buying and owning computers. One theme was sounded over and over: It's not just a great computer you want; it's what we can do to make sure you'll get the most out of your computer.

Based on millions of conversations with our customers, we've made dramatic additions to our services to help you get the most out of your computer.

So we studied every area where we could help, from hardware to compatibility, from telephone response to service. The result was some fairly dramatic changes at Dell to make computing easier now, and in the future.

We added new services and specialists so you can get faster help. We involved our suppliers and software developers to find new ways to ensure compatibility. Most important, in the three key areas where you want assurances—compatibility, quick answers and fast service—we're offering something completely foreign to other computer companies: guarantees.

We're offering something no other computer company offers: guarantees.

HOW CAN A COMPUTER BREAK MURPHY'S LAW? We started with state-of-the-art technology. Integrated 1024 x 768 VGA support, for instance, is included on all Dell® desktop systems—even our entry-level i386™SX system. For BIOS upgrading, all i486™ systems have FLASH EPROMs. The SmartVu™ diagnostic display and programmable reset switch are standard on both the mid-sized and floorstanding systems. And to make sure you get exactly what you want, every system can be custom-configured to your specifications.

Every Dell i486 system has FLASH EPROMs for easy BIOS upgrading.

We've also implemented what we call the "total ownership experience." We added specialists to help you with each step you take in owning a computer, from purchasing to set-up to servicing to upgrading. You can expect quick answers from our unique Getting Started Helpline,* custom integration services, award-winning phone support, and our 24 hour-a-day TechFax™ lines for system information.

IRON CLAD GUARANTEES. We know you want your Dell system to be compatible with new products in the future. We know you want quick answers to your questions. And we know you want fast service.

So we guarantee you'll get all of it. This isn't a promise, it's a guarantee. You can read about the guarantees in the following pages.

They should make everybody happy. Except maybe our competitors. And Murphy.

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MURPHY'S LAW #77

THE ONLY PRODUCTS YOUR COMPUTER WILL NOT WORK WITH ARE THE ONES YOU REALLY NEED.

INTRODUCING GUARANTEED COMPATIBILITY.

We've discovered a common phobia among computer shoppers. They're afraid the computer they're about to buy won't run everything they'll need in the future.

At Dell, one of our main goals when we design systems is compatibility. We have a state-of-the-art lab where our engineers do nothing but make sure our computers run other vendors' products. We configure our systems with third-party boards and hundreds of packages in virtually every possible permutation. With thousands of configurations behind our computers, we often find situations that will "break" the system. Then we find a way to make it all work, so you don't have to.

For particularly tough situations, we can rewrite parts of the BIOS for you.

We also have strategic relationships with the people who make those new products. For example, if you have a problem with system software from Novell, Banyan, SCO, Microsoft or IBM, we'll use our alliances with these companies to bring everyone together to solve your problem.

We guarantee we'll work with you to ensure compatibility with products introduced in the future.

WHAT ABOUT NEW PRODUCTS? As we said, our systems are designed to be compatible today and tomorrow. But if a new product is released, and your system is not compatible, we can provide free BIOS changes, if that will make them work together. For complex situations, we can modify the BIOS for you. And for the particularly tough problems, we have specialists in areas such as networking, UNIX® and graphics. No one can predict the future. But we'll do everything we can to make your system compatible as quickly as possible.

DOESN'T ANYONE ELSE GUARANTEE COMPATIBILITY? In a word, no. Oh sure, you could probably squeeze a few vendors for some compatibility assurances. But when you try to get them in writing, they're a bit tougher to get.

We constantly create compatibility situations that will "break" the system, then find a way to make it work—so you don't have to.

OUR COMPATIBILITY GUARANTEE: Dell systems are designed and tested to run all standard operating systems, application software, peripherals and network operating systems developed for ISA and EISA architecture systems. If you encounter a compatibility problem with your Dell Performance Series system within three years of the original purchase, we guarantee Dell's engineers and technicians will work with you to identify the cause of the problem and recommend a solution. If the problem (other than software support for device drivers) can be solved by updating your system, we'll provide the change at no charge. Or, in the rare event we can't do that, you may return the system for a refund. You understand that we can't extend the guarantee to software or devices that were never intended to run on comparable ISA or EISA systems of the same vintage.[1]

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[1]*Refund value is based on the sum of years digits depreciation of the original purchase price over a three-year period, calculated monthly. Refund offer is valid for registered owners of Dell Performance Series systems purchased after July 1, 1992. Guarantee not applicable outside the U.S. and subject to change without notice.*

MURPHY'S LAW #13

THE MORE DESPERATE YOUR PHONE CALL, THE LONGER YOU WILL BE PUT ON HOLD.

INTRODUCING GUARANTEED RESPONSE.

Having trouble formatting your hard disk? Need somebody to explain the mysteries of MS-DOS 5.0? Can't set your modem switch?

If you have a Dell computer, you can call us and get all the help you need without umpteen call transfers or endless choruses of "Tie A Yellow Ribbon." We've put together a remarkable system that enables our trained technicians to solve most reported problems over the phone, usually in 10 minutes or less.

It works like this: Calls made to Dell Technical Support are entered into our system. If our technicians run into a problem they can't solve, they access the Problem Resolution Database. Chances are a similar problem—and solution—have been entered in the past. We also keep a complete history of your own computer. Over time, we'll get to know your system as well as you do. Maybe even better.

We solve most problems over the phone within 10 minutes.

And the price of your system includes 7 day-a-week, 18 hour-a-day,* toll-free phone support for as long as you own your Dell computer.

THE DELL WHATEVER-IT-TAKES APPROACH TO CUSTOMER SATISFACTION begins the moment you receive your computer. For the first 30 days, you'll have a special toll-free Getting Started Helpline* staffed by people who speak plain English, not Fortran. If you need system information, it's available 24 hours a day via our innovative TechFax line. Just dial up and the detailed information you requested will be automatically faxed to you from the Dell Technical Library. We also have our own Dell Forum on CompuServe's Information Service so you can see other users' problems, and more importantly, our solutions.

24-hour system information is available on our TechFax Line.

All these services haven't gone unnoticed by our customers. We've won *PC Week's* Customer Satisfaction Poll an unprecedented eight times, won *PC World's* World Class Award for Best Service, and ranked among the top of *PC Magazine's* customer service and reliability survey.

OUR RESPONSE GUARANTEE: We guarantee when you call our technical support center with a problem during operating hours (6AM-12 Midnight CT daily),* you will talk to a technical specialist within 5 minutes. If you do not wish to hold for a technician, we guarantee your call will be promptly returned by a technical specialist within one hour. In the rare event you don't reach a technician or a technician doesn't call back within one hour, let us know and you will receive your choice of a check for $25 or a credit of $25 toward your next purchase.[2]

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[2]This guarantee begins August 1, 1992 and applies to registered owners of Dell Performance Series systems purchased after July 1, 1992, but only one award per system per day. Please understand that the guarantee does not apply to support calls missed for reasons clearly outside of our control, such as power outages and interruptions to telephone service; or outside the U.S. Subject to change without notice.

MURPHY'S LAW #31

THE MORE URGENT THE PROBLEM, THE LONGER IT WILL TAKE FOR SERVICE.

INTRODUCING GUARANTEED NEXT-BUSINESS-DAY SERVICE.

We heard what people had to say about service they've had elsewhere, and it wasn't very nice.

So instead of giving you the usual reliability story, we'll give you the straight scoop.

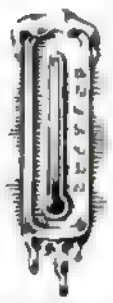
We guarantee a trained technician will be at your desk by the end of the next business day, if needed.

THE STANDARD SERVICE IS ANYTHING BUT STANDARD. When we find out you have a problem, a trained technician will be at your desk the next business day if necessary. The next-business-day service is backed by a $65 million parts inventory. (That's probably ten times more inventory than most resellers' revenue.) It's also supported by an overnight parts shipment and a field service force that boasts hundreds of certified NetWare® technicians.△

If our next-business-day service isn't fast enough for you, there is the option, in many areas, of upgrading to Critical Care,™ 4-hour service.*

You can even sign up for these service commitments for as long as four years.

Think of them as long-term insurance against Murphy's Law.



Every Dell system is tested for extremes of heat, cold, shock and vibration.

HERE'S A NOVEL IDEA: WE'VE DESIGNED THEM SO THEY WOULDN'T BREAK DOWN. For added confidence, we design our systems from the ground up rather than rely on dubious imports. With quality components rather than the rejects some vendors pick up on the open market.

Every Dell system is tested for extremes of heat, cold, vibration and shock. It features specially designed air cooling systems to keep noise and temperature levels low. Highly integrated systems boards minimize the number of connections and parts, so there are fewer things to go wrong.

OUR SERVICE GUARANTEE: If there is a hardware failure with your Dell system while under a service contract purchased from Dell and you notify us before 5:00 PM CT, a technician, if needed, will arrive to address your problem by the end of the next business day. In the rare event the technician does not arrive as promised, let us know and your situation will receive top priority for resolution, plus you will receive an additional month of service at no cost to you.[3]

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[1]This guarantee begins August 1, 1992 and applies to registered owners of Dell Performance Series systems purchased after July 1, 1992. Please understand that the guarantee does not apply to service calls missed for reasons clearly outside of our control, such as the interruptions to telephone service and the closure of airports required for parts delivery; or outside the U.S. Subject to change without notice.

MURPHY'S LAW #69

THE MORE
YOU ASK
FROM YOUR
COMPUTER
COMPANY,
THE HARDER
IT'LL BE
TO GET IT.

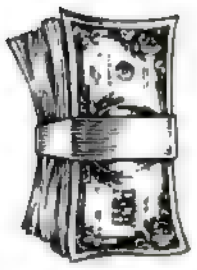
INTRODUCING GUARANTEED SATISFACTION.

If someone ever does a survey to find the response most hated by a computer company's clients, it will probably be this: "It can't be done."

Companies that say things like that put their rules before your problems.

At Dell, we put your problems before our rules.

Depending on your circumstances, we offer a variety of specialized services like comprehensive system integration and preconfiguration, and preloading of popular and custom software.

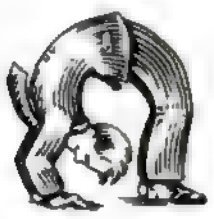


If, after 30 days, you're still not happy, we'll give your money back with no questions asked.

GET MICROSOFT, INTEL AND NOVELL TO WORK FOR YOU. We have close working relationships with industry leaders like Microsoft, Intel and Novell, and can enlist them to help plot a corporate IS strategy.

With the help of other business partners, we can do things like tailor a support package for you or arrange remote diagnostics for remote sites.

Our flexibility goes beyond our own products. For large projects, we can acquire and integrate over 5000 non-Dell products, so you don't have to go to a hundred different vendors to get your system together.



We're more flexible, to help you get the most out of your computing.

OUR SATISFACTION GUARANTEE: To show you we mean what we say, we'll give you a 30-day, no-questions-asked, money-back guarantee with each computer.

THE LAST GUARANTEE. Computer companies are notorious for broken promises. So, as you've read, we're not making promises. We're making guarantees. Guaranteed compatibility. Guaranteed quick answers. Guaranteed fast service. And guaranteed satisfaction.

Our philosophy of putting your problems before our rules is why two-thirds of the FORTUNE 500® buy from Dell. It's a philosophy that made us an $890 million company. And it's a philosophy we'll continue.

We guarantee it.

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Fax Software for DOS

WinFax PRO
Fax Software for Windows

If you're already a WinFax PRO user and want to take advantage of DOS-based faxing, you'll be happy to know that all your WinFax PRO files and phone books are 100% compatible with DosFax PRO.

And if you're using any Delrina fax product, simply upgrade to either WinFax PRO or DosFax PRO. You'll add a host of powerful features that let you make the most of faxing from your PC.

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CIRCLE 250 ON READER SERVICE CARD

What the Numbers Mean: *Portable PCs*

Of the 65 monochrome notebook systems we tested, 6 used an Intel 486 processor, and all relied solely on the processor's internal 8K primary cache. The remaining notebooks all used some variant of the 386 architecture running at 33 MHz, 25 MHz, or 20 MHz: 47 Intel-based systems (1 386DX, 30 386SX, and 16 386SL units) and 12 AMD-based systems (2 Am386DXL/25s and 10 Am386SXLs). Of the 58 386-based systems, including all 3 of the 386DXs, 19 used a secondary RAM cache. Of these cached notebooks, 16 have a four-way set-associative cache organization, since it allows for smaller SRAM capacities (16K, 32K, or 64K).

We found little deviation in performance across the different CPU types. The 486 notebooks proved faster than the 386s, and cached 386s outperformed noncached models. The Compudyne 486DX/33 and the Tandy 4860 HD, the only notebooks to use 486DX chips running at 33 MHz, were tied in terms of processor and memory performance.

The lone 486DX/25, the Gateway Nomad 425DXL, fell amid the two 25-MHz Toshiba T4400SXs and the 486SX/20 Gateway Nomad 420SXL when it came to processor performance. The four remaining 486 systems were relatively close to each other on these two tests.

Only 3 of the 59 386-based systems used the 386DX processor; the others used a 386SX, 386SXL, or 386SL chip. The 386DX/33 Aquiline NT33 with its 32K four-way set-associative cache proved faster than the Am386DXL/25-based Blue Star 386DX/25 Notebook or the Micro Express NB2500 Notebook. With a memory score of 4,045 kilobytes per second, the Aquiline outpaced the two 25-MHz systems, which use 128K direct-mapped caches to achieve memory scores averaging 2,667 KBps. The Aquiline's winning performance was not due only to its 33- to 25-MHz operation. PC Magazine Labs has found that set-associative caches generally lead to better performance.

The same held true for the 386SX systems we looked at. The eight best 25-MHz systems on our processor and memory tests are based on the Intel 386SL with a RAM cache. The only uncached 386SL notebook, the Compudyne 386SXL/25, exhibited performance that was solidly grounded among the noncached AMD and Intel SX portables. The 20-MHz 386 units were also dominated by cached systems in terms of processor and memory performance.

DISK

The most striking disk performance came from three 386s. While the Compudyne 486DX/33's 130MB 19-millisecond IDE Toshiba hard disk was the fastest, the next best performers were the three 386SX- and SL-based NEC UltraLite notebooks: The UltraLite SL/20 and its twin, the UltraLite SL/20P, both use the 80MB Quantum Go•Drive, an IDE hard disk rated at 16 ms. The NEC UltraLite III's 60MB Conner CP-2064, an IDE unit rated at 19 ms, was tied for second place. The Conner and the Quantum units both feature 32K buffers to enhance performance.

VIDEO

Toshiba submitted two variants of its 25-MHz T4400SX, one with a Matsushita gas-plasma display and the other with a Sharp LCD. The plasma system was only slightly faster on our DOS-based video test and the Graphics Winmark test. Both machines used identical Western Digital WD90C23 video chip sets.

The top 386 video performer was the Compaq LTE Lite/25, with a video score of 3,024 thousand operations per second and a Graphics Winmark score of 1.8 million. In fact, Compaq's two 20-MHz units are among the top five video performers in the 386 class, but the Gateway Nomad 325SXL with its Cirrus GD6420 video chip set bested both LTE Lites in terms of Windows graphics performance, with its Winmark score of 1.6 million. Rounding out the top five video performers in the 386 group was the Tandy 3830 SL, with a video score of 2,091 thousand operations per second and a Winmark score of 1.5 million.

A notable disappointment was the Dell System NL25, which turned in a Winmark score of just 0.7 million. It was also sixth from the bottom on our video test. We attribute the lackluster performance to the combination of a Cirrus 610/620 chip set with Dell's own video BIOS. The more expensive Dell System 325N turned in respectable scores, thanks to its Western Digital WD90C22/WD90C5 chip set and Phoenix video BIOS.

1.44MB floppy disk drive; DOS 5.0; and Microsoft Windows 3.1. Blue Star Computers charges $2,899 for the unit; Micro Express provides the better value, though, offering its system with a 9,600-bps fax modem for $2,925.

The charcoal-gray cases are the same, measuring 2.5 by 8.3 by 11 inches and weighing 7.5 pounds with its nickel cadmium battery. You can't add more RAM yourself, but if you want the 8MB maximum, you can order an 8MB SIMM in a single socket on the motherboard. The video subsystem pairs a Sanyo 8.5-inch diagonal LCD, a CCFT (cold-cathode fluorescent tube) supertwist backlit screen capable of 64 shades of gray, with a Cirrus Logic GD610/620 video chip set.

Both machines yielded average performance for their class. The battery life, accessible through a panel above the keyboard, varied slightly between machines on our Battery Rundown test. The Blue Star 386DX/25 lasted 2 hours 12 minutes and 3 hours with power-conservation features enabled; the Micro Express NB2500 stayed alive slightly longer, at 2 hours 28 minutes, but turning on power conservation showed little improvement. You access these features in CMOS setup, which you enter by pressing the Delete key as the unit boots. Features include a doze mode, which switches the system clock to

Benchmark Tests: Portable PCs

The results from this roundup clearly demonstrate that 486s are faster than 386s. No matter what the CPU, though, make sure your next notebook has a processor RAM cache if you're looking for speed.

HOW WE TESTED

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure each PC's processor, memory, disk, and video subsystem performance. Each test measures the number of operations performed or the data throughput over a period of time. We also used WINBENCH 2.5 to obtain the Graphics Winmark scores. In all cases, a larger number means better performance.

We performed all the tests with the RAM and video cache shadowing enabled whenever possible. We report the disk performance without software disk caches.

The **processor** test measures different aspects of the CPU's performance and its interaction with cache and main memory. The test consists of eight routines: an Instruction Mix native to the microprocessor type (386 or 486, for instance) and 128K No-Operation, Do-Nothing, Integer-Add, Integer-Multiply, Floating-Point Mix, String-Sort and -Move, and Prime-Number Sieve routines.

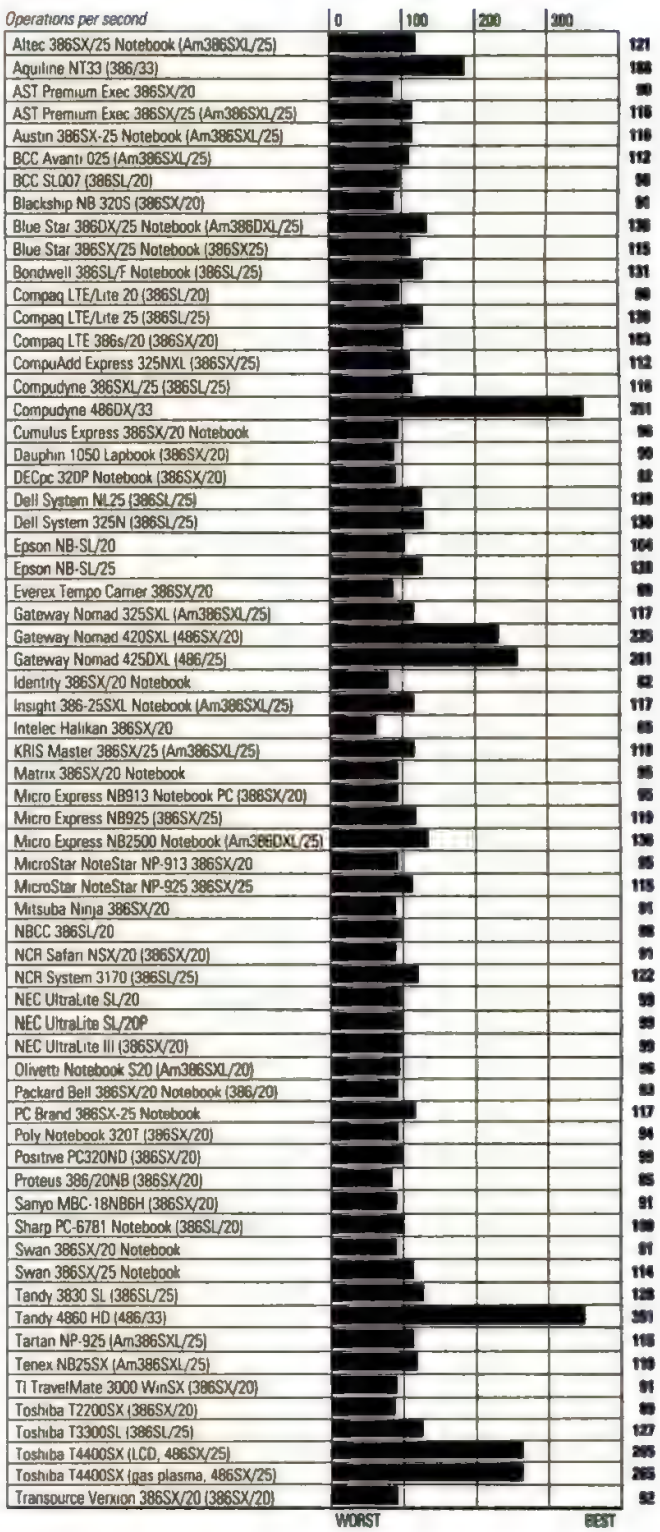
The **memory** benchmark test measures the read/write performance of the computer's first 640K of conventional memory.

The **disk** benchmark test evaluates the mechanical drive speed, hard disk controller functions, and bus speed, using a series of small-record (512-byte and 4K) exercises followed by similar large-record (16K and 32K) exercises. Both small- and large-record exercises include file-create, sequential write/read, and random write/read operations.

The **video** benchmark test consists of text and graphics routines. In the Direct Screen Write routine, the video adapter's screen memory writes text to the screen. The test then performs several graphics operations, including screen fills and bit-block transfers (BitBlts).

With the release of Version 2.5 of PC Labs' WINBENCH tests (our graphics performance tests for Microsoft Windows), PC Labs has introduced a new method of measuring graphics performance. The **Graphics Winmark** is the geometric mean of 12 WINBENCH graphics tests, measured in millions of pixels per second. PC Labs profiled the major Windows applications in November 1991 and determined which graphics functions are most frequently used within Windows. The Winmark takes into account 12 tests of these key functions and weights them to reflect how frequently the functions are used. Windows applications also use other graphics functions, but far less often.

PROCESSOR



MEMORY

Kilobytes per second

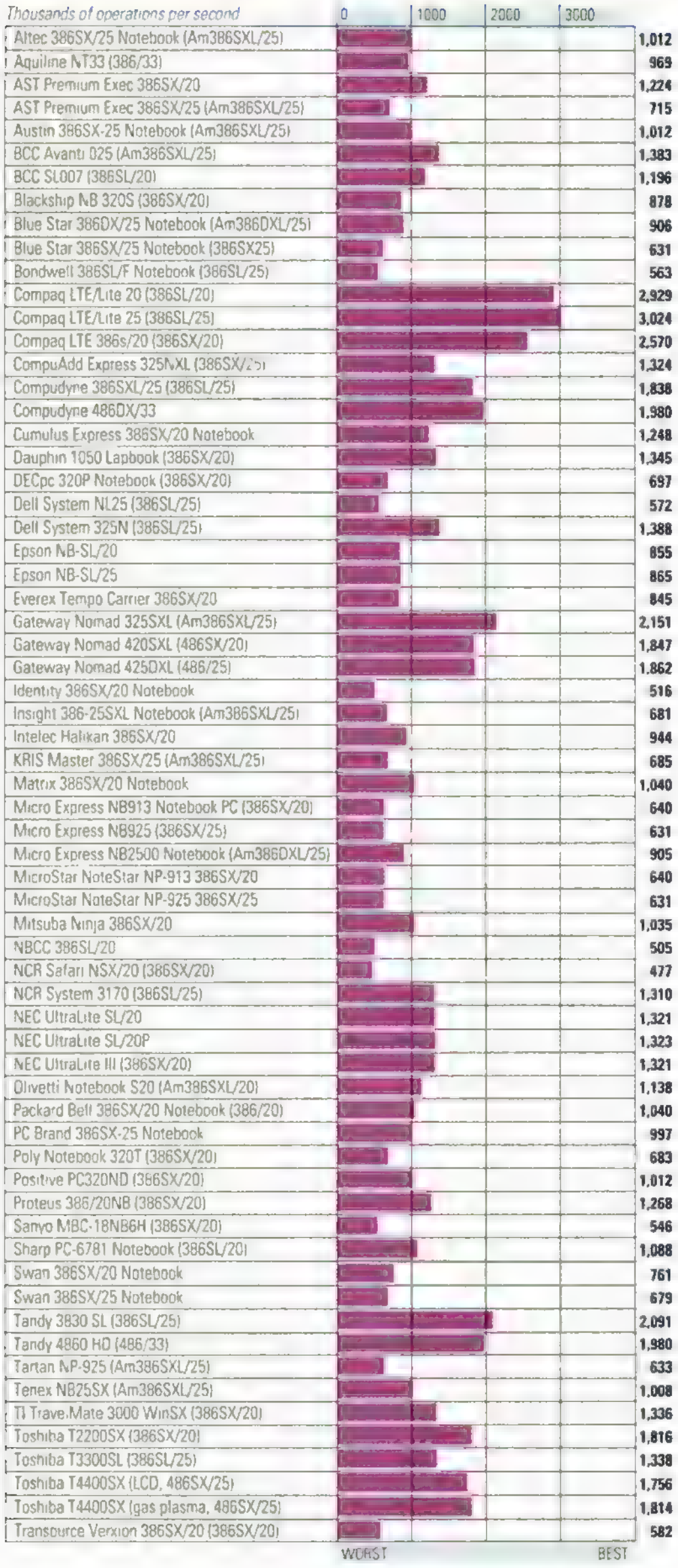
Altec 386SX/25 Notebook (Am386SXL/25)	2,106
Aquiline NT33 (386/33)	4,045
AST Premium Exec 386SX/20	1,753
AST Premium Exec 386SX/25 (Am386SXL/25)	2,028
Austin 386SX-25 Notebook (Am386SXL/25)	2,282
BCC Avanti 025 (Am386SXL/25)	2,188
BCC SL007 (386SL/20)	2,122
Blackship NB 320S (386SX/20)	1,795
Blue Star 386DX/25 Notebook (Am386DXL/25)	2,656
Blue Star 386SX/25 Notebook (386SX25)	2,205
Bondwell 386SL/F Notebook (386SL/25)	3,301
Compaq LTE/Lite 20 (386SL/20)	2,000
Compaq LTE/Lite 25 (386SL/25)	2,735
Compaq LTE 386s/20 (386SX/20)	2,349
CompuAdd Express 325NXL (386SX/25)	2,194
Compudyne 386SXL/25 (386SL/25)	2,073
Compudyne 486DX/33	5,330
Cumulus Express 386SX/20 Notebook	1,860
Dauphin 1050 Lapbook (386SX/20)	1,622
DECpc 320P Notebook (386SX/20)	1,468
Dell System NL25 (386SL/25)	2,729
Dell System 325N (386SL/25)	2,903
Epson NB-SL/20	2,526
Epson NB-SL/25	2,736
Everex Tempo Carrier 386SX/20	1,588
Gateway Nomad 325SXL (Am386SXL/25)	2,400
Gateway Nomad 420SXL (486SX/20)	3,910
Gateway Nomad 425DXL (486/25)	4,887
Identity 386SX/20 Notebook	1,400
Insight 386-25SXL Notebook (Am386SXL/25,	2,117
Intelec Halikan 386SX/20	1,142
KRIS Master 386SX/25 (Am386SXL/25)	2,177
Matrix 386SX/20 Notebook	1,549
Micro Express NB913 Notebook PC (386SX/20)	2,005
Micro Express NB925 (386SX/25)	2,118
Micro Express NB2500 Notebook (Am386DXL/25)	2,678
MicroStar NoteStar NP 913 386SX/20	2,005
MicroStar NoteStar NP-925 386SX/25	2,212
Mitsuba Ninja 386SX/20	1,525
NBCC 386SL/20	1,920
NCR Safari NSX/20 (386SX/20)	1,669
NCR System 3170 (386SL/25)	2,685
NEC UltraLite SL/20	2,345
NEC UltraLite SL/20P	2,345
NEC UltraLite III (386SX/20,	2,345
Olivetti Notebook S20 (Am386SXL/20)	1,968
Packard Bell 386SX/20 Notebook (386/20)	1,642
PC Brand 386SX 25 Notebook	2,212
Poly Notebook 320T (386SX/20)	1,767
Positive PC320ND (386SX/20)	2,140
Proteus 386/20NB (386SX/20)	1,839
Sanyo MBC-18NB6H (386SX/20)	1,363
Sharp PC-6781 Notebook (386SL/20)	2,351
Swan 386SX/20 Notebook	1,724
Swan 386SX/25 Notebook	1,669
Tandy 3830 SL (386SL/25)	2,586
Tandy 4860 HD (486/33,	5,330
Tartan NP-925 (Am386SXL/25)	2,212
Tenex NB25SX (Am386SXL/25)	2,150
TI TravelMate 3000 WinSX (386SX/20)	2,028
Toshiba T2200SX (386SX/20)	1,949
Toshiba T3300SL (386SL/25)	2,744
Toshiba T4400SX (LCD, 486SX/25)	4,795
Toshiba T4400SX (gas plasma, 486SX/25)	4,809
Transource Verxion 386SX/20 (386SX/20)	1,652

DISK

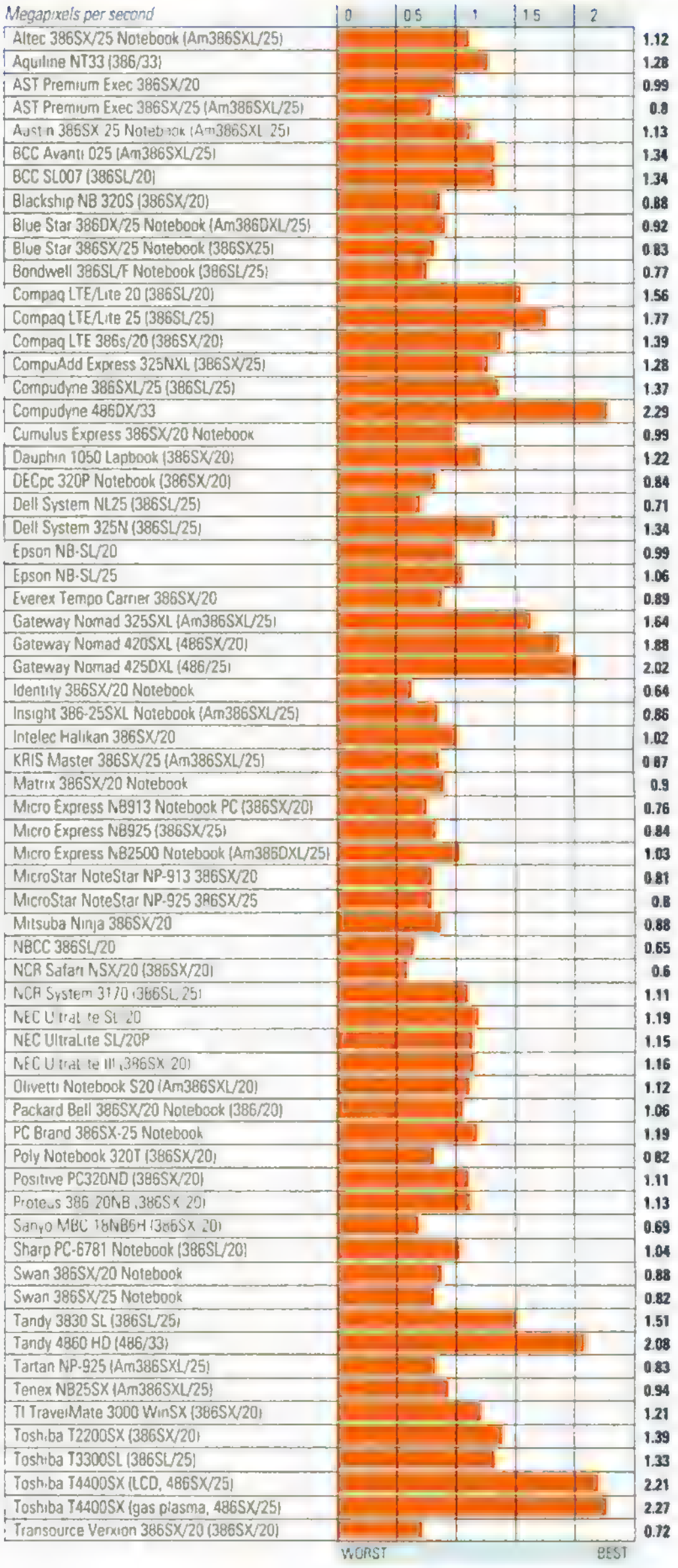
Kilobytes per second

Altec 386SX/25 Notebook (Am386SXL/25)	88
Aquiline NT33 (386/33)	103
AST Premium Exec 386SX/20	87
AST Premium Exec 386SX/25 (Am386SXL/25)	87
Austin 386SX-25 Notebook (Am386SXL/25)	87
BCC Avanti 025 (Am386SXL/25)	90
BCC SL007 (386SL/20)	37
Blackship NB 320S (386SX/20)	99
Blue Star 386DX/25 Notebook (Am386DXL/25)	87
Blue Star 386SX/25 Notebook (386SX25)	89
Bondwell 386SL/F Notebook (386SL/25)	87
Compaq LTE/Lite 20 (386SL/20)	87
Compaq LTE/Lite 25 (386SL/25)	88
Compaq LTE 386s/20 (386SX/20)	86
CompuAdd Express 325NXL (386SX/25)	89
Compudyne 386SXL/25 (386SL/25)	90
Compudyne 486DX/33	145
Cumulus Express 386SX/20 Notebook	84
Dauphin 1050 Lapbook (386SX/20)	55
DECpc 320P Notebook (386SX/20)	85
Dell System NL25 (386SL/25)	90
Dell System 325N (386SL/25)	88
Epson NB-SL/20	82
Epson NB-SL/25	85
Everex Tempo Carrier 386SX/20	86
Gateway Nomad 325SXL (Am386SXL/25)	86
Gateway Nomad 420SXL (486SX/20)	92
Gateway Nomad 425DXL (486/25)	103
Identity 386SX/20 Notebook	86
Insight 386-25SXL Notebook (Am386SXL/25)	82
Intelec Halikan 386SX/20	78
KRIS Master 386SX/25 (Am386SXL/25)	86
Matrix 386SX/20 Notebook	83
Micro Express NB913 Notebook PC (386SX/20)	92
Micro Express NB925 (386SX/25)	73
Micro Express NB2500 Notebook (Am386DXL/25)	79
MicroStar NoteStar NP-913 386SX/20	91
MicroStar NoteStar NP-925 386SX/25	85
Mitsuba Ninja 386SX/20	88
NBCC 386SL/20	56
NCR Safari NSX/20 (386SX/20)	85
NCR System 3170 (386SL/25	86
NEC UltraLite SL/20	140
NEC UltraLite SL/20P	139
NEC UltraLite III (386SX/20)	140
Olivetti Notebook S20 (Am386SXL/20)	83
Packard Bell 386SX/20 Notebook (386/20)	88
PC Brand 386SX 25 Notebook	97
Poly Notebook 320T (386SX/20)	89
Positive PC320ND (386SX/20)	84
Proteus 386/20NB (386SX/20)	68
Sanyo MBC-18NB6H (386SX/20)	86
Sharp PC 6781 Notebook (386SL/20)	87
Swan 386SX/20 Notebook	82
Swan 386SX/25 Notebook	85
Tandy 3830 SL (386SL/25)	70
Tandy 4860 HD (486/33)	98
Tartan NP-925 (Am386SXL/25)	90
Tenex NB25SX (Am386SXL/25)	86
TI TravelMate 3000 WinSX (386SX/20)	92
Toshiba T2200SX (386SX/20)	84
Toshiba T3300SL (386SL/25)	87
Toshiba T4400SX (LCD, 486SX/25)	87
Toshiba T4400SX (gas plasma, 486SX/25)	90
Transource Verxion 386SX/20 (386SX/20)	89

VIDEO



GRAPHICS WINMARK



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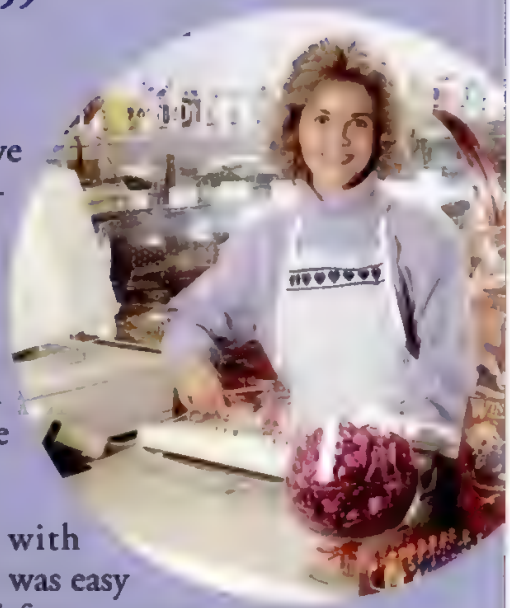

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CIRCLE 321 ON READER SERVICE CARD

SUITABILITY TO TASK

Blue Star 386DX/25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	●	○

SUITABILITY TO TASK

Micro Express NB2500 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	●	○

a lower speed during hard disk inactivity; standby mode; and a mode that shuts off the LCD between keystrokes.

Despite a smooth, clicky feel, the keyboard has some drawbacks: no dedicated Home, End, PgUp, or PgDn keys; no inverted-T cursor-key arrangement. The function keys are not full-height, and the Spacebar is a bit small, but the Enter, Backspace, Tab, and Shift keys are large. You can tilt the LCD screen back if you need to view it from a different angle. Ports on the back of each unit include a 9-pin serial port, a parallel port that can accept an external 1.2MB floppy disk drive, a built-in scanner port, an expansion port for the expansion chassis, and an external monitor and keyboard port.

Both companies offer similar options

FACT FILE

Blue Star 386DX/25 Notebook

Blue Star Computers Inc., 2312 Central Ave. NE, Minneapolis, MN 55418; 800-950-8884, 612-788-5000; fax, 612-788-3442

List price (tested configuration): $2,899.

Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case.

Options: 4MB RAM upgrade, $289; external floppy disk drive, $249; math coprocessor, $130, external keyboard $59.95; numeric keypad, $125; expansion chassis, $359; extra battery, $75; battery charger, $120; car battery adapter, $140; 9,600-bps fax modem, $225.

321 ON READER SERVICE CARD

MOVING?

Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

Your Portable Laptop Guide

This *PC Magazine* foldout contains a summary of the information you're likely to need while traveling: modem commands, electronic service phone numbers and command summaries, international voltage information, and more.

GETTING READY FOR THE ROAD

Before you travel, go through these steps:

Tape business cards to the bottoms of your laptop, transformer, portable modem, and portable printer. Should you leave something in a hotel, it's more likely to be returned if it has this identification. Also add these ECHOed or REMed lines at the bottom of your AUTOEXEC.BAT file: "ECHO If Found Please Contact <Enter> ECHO *your name and phone number* <Enter> ECHO Reward <Enter>".

Make and carry a bootable DOS floppy disk for use in case you damage one of the startup files and your laptop can't boot itself. Also consider carrying floppy disk copies of key applications.

Make sure you have all your hardware: mouse or portable trackball, transformer, transformer-to-AC outlet plug, spare battery, extra floppy disks, file-transfer cable, printer cable, spare 9- or 1.5-volt batteries for external modems.

Make a list of any special commands you need to operate your laptop (how to turn on the modem or external video) if your laptop doesn't have a carry-along compact reference guide.

Make a list of personal dial-up phone numbers and passwords for your office LAN's dial-in connection and local BBSs you use on the road.

Carry these tools and accessories:

- RJ-11 phone cable. A must-have (don't buy the handset cord cable, which looks the same but doesn't fit).
- Small flat-bladed and Phillips-head screwdrivers.
- Miniature flashlight.
- In-line phone cord coupler (to make one long phone cord out of two shorter cords).
- Modular duplex phone jack, a plug-in Y connector that gives you two phone jacks in place of one (this can also be used as an in-line coupler).
- Modular-to-spade-lug line: a standard RJ-11 or RJ-14 phone plug at one end, four color-coded wires at the other. Attach small alligator clips to the red and green wires, and use this to make direct connections to the phone if no wall or phone jack is accessible. Connect the red and green wires to the red and green wires at the wiring block (wall outlet) or to the two contacts on the phone mouthpiece.
- International line-cord power plug adapter and international telephone adapter (RJ-11-to-PTT adapter); available through electronics supply shops in large cities, or contact your laptop maker.

TRAVEL TIPS

To avoid conflicts with airline baggage limitations, replace your laptop carrying case and briefcase with one larger carrying case.

Consider joining an airline travelers' club (such as Admirals or Red Carpet)—$75 to $150 yearly—for airport access to RJ-11 phone jacks, AC power connections, and in some cases computers.

Baggage inspection equipment produces X rays, which affect film but not computers. (Magnetism affects computers.)

To stretch your battery, turn the CPU to slow, turn down the display intensity, power-down the serial and parallel ports, don't use the hard disk (let it spin down), and do use a disk cache (to keep from accessing the hard disk). Fully discharge your battery before recharging it.

Hotel electrical outlets may be switch-controlled. Be sure the switch by the door does not turn off the AC outlet recharging your computer.

Set up your laptop software for LCD (preferred) or monochrome display, not color, not black-and-white. Choosing "color" may give you a combination you can't read.

Rather than carrying a printer, send yourself a fax at your hotel using an e-mail service or a fax modem.

Some battery-powered external modems remain on (drawing power) whenever connected to the PC. Turn the modem off or disconnect it.

"Call waiting" knocks your modem off the line. To cancel the feature for one phone call, add "*70" (sometimes "#70") at the beginning of the dialing string.

Useful phone numbers: Naval Observatory Clock (exact time—voice), 900-410-8463; NIST Clock (exact time—modem), 303-494-4774; weather, 900-123-4567.

MAKING PHONE CONNECTIONS

Connect your computer to a phone system (as in a hotel) in one of these ways, which are listed in increasing order of difficulty. Below, "your laptop" means the RJ-11 phone cord from your modem; "wall outlet" means the phone outlet, not the AC outlet. Some phones are hard-wired (with no modular connector) at one end but not the other. Use one of these ways to connect:

- Plug your laptop into the data port on the telephone.
- Unplug the telephone and plug the phone cord into your modem jack.
- Unplug the telephone at the wall outlet; plug your laptop into the wall outlet.
- If your modem has two jacks and you want the phone to remain usable, unplug the phone at the wall outlet. Plug the phone into the modem. Plug the modem into the wall outlet.
- If you want the phone to remain connected and you have only one modem jack, plug a modular duplex connector (Y connector) into the wall outlet. Plug both the phone and your laptop into the Y connector. (The Y connector may also connect to the back of the phone, but not securely. A rubber band will hold it in place.)
- If the phone cord disappears into the wall behind a wall plate, undo the two screws on the wall plate. There may be a modular jack inside.
- If there's no modular jack behind the wall plate but you can see a wiring block with red and green connectors, use a modular-to-spade-lug connector (with alligator clips on the red and green lug ends). Connect the red and green alligator clips to the wiring block's red and green wires; connect the RJ-11 jack to your modem. You can then dial as usual. (Caution: Phone line voltage is minimal except when the phone is ringing.)
- Undo the mouthpiece on the telephone, exposing two silvery contacts. Connect the modular-to-spade-lug connectors to the contacts; connect the other end to your laptop. Take the handset off the hook just before you dial, and leave it off until your communication session finishes.
- If there's a bathroom phone, it may slide off with a good tug, exposing an RJ-11 jack. (You may have to start by manipulating a locking lever on one side of the phone.)
- Use a handset coupler. Unplug the handset. Plug the handset coupler into the phone. Plug the handset and your laptop RJ-11 cord into the handset coupler. (The two plugs look similar but are different; you'll find that handset jacks are more often standardized than RJ-11 wall plugs.) This also works with digital phones.
- Use an acoustic coupler connected to the handset. Good couplers can handle 2,400 bps, and possibly 9,600 bps on good lines.
- Use the hotel business center.
- Ask the hotel to unplug its fax machine temporarily. Any line a fax machine uses will work for your modem. If the day-shift staff says no, ask again in the evening.

Tip: Hotels sometimes break off the tip of the locking lever on the phone's RJ-11 cord as a rudimentary security measure. Use a small pocketknife or flat-blade screwdriver to release the RJ-11 plug.

HAYES-COMPATIBLE MODEM COMMANDS

Most modems are Hayes-compatible and use the Hayes commands. Commands begin with "AT" (for "attention, modem") and end with a Return (<Enter>). Exceptions: "A/" (repeat last command) and "+++" (escape sequence, interrupt modem) don't use "AT" or <Enter>.

If you're stringing commands together, you need the "AT" only before the first command. Extra spaces and most punctuation (such as hyphens in phone numbers) are ignored. Capitalization usually doesn't matter ("AT" = "at"). Modems can't dial vanity numbers ("800-BIG-GULP"). Transcribe command strings carefully; don't confuse 0 (zero) with O (oh) or 1 (one) with l (ell).

City	Speed (bps)	Phone number
Portland, Oregon	2,400	503-239-6124
	9,600	503-238-6729
Sacramento, California	2,400	916-484-1112
	9,600	916-482-4494
St. Louis, Missouri	2,400	314-241-5337
	9,600	314-421-5651
San Diego, California	2,400	619-569-4282
	9,600	619-467-9508
San Francisco, California	2,400	415-296-8362
	9,600	415-434-1580
San Jose, California	2,400	408-988-5366
	9,600	408-727-8113
Seattle, Washington	2,400	206-242-5767
	9,600	206-242-9992
Washington, D.C.	2,400	202-388-3303
	9,600	703-591-0461

CompuServe Command Basics

Many commands can be abbreviated to one, two, or three characters. You can enter them at any CompuServe prompt, the most frequent prompt being the exclamation point (!). If you don't wish to learn the commands, simply enable the Menu option (the default) and move through them. You can type "HELP" at any prompt.

Command	Description
M	MENU (previous).
T	Go to TOP of menu page.
F	FORWARD a page.
B	BACK a page.
H	HELP.
R	RESEND.
S N	SCROLL output.
G *N*	GO to page *n*.
N	NEXT menu selection.
P	PREVIOUS menu selection.
HELLO	Log on again.
END, OFF, BYE	Hang up (end the session).
EXIT	Exit a forum (don't hang up).
Ctrl-C	Interrupt display, go to prompt.
Ctrl-S	Pause display of information.
Ctrl-Q	Resume display of information.

The GO command bypasses the menu structure. If you know where you want to go, GO is faster. Type "GO" and the name of the area you want to access. "GO IBMSW", for example, takes you to the IBM-compatible software forum. To find an area of interest, enter "FIND" and a topic name.

GO Command	Description
GO BILLING	Review your bill or change address.
GO COMMAND	View summary of commands
GO FEEDBACK	Ask a question or complain.
GO HELP	View help and instructions.
GO LOGON	Review log-on procedures.
GO PHONES	Find local access numbers.
GO PASSWORD	Change your password.
GO PROFILE	Change display or service options
GO RATES	View rate information.
GO DIRECTORY	Find a member by last name.
GO PRACTICE	Free practice.

GEnie

GEnie (the General Electric Information Service) is smaller and cheaper than CompuServe or Prodigy, especially during off-hours. Electronic mail is free and includes binary files (1-2-3 worksheets and programs).

800-638-9636	Information/sign-up (voice).
800-638-8369	Information/sign-up (modem)
Comm settings	8 data bits, no parity, 1 stop bit (8-N-1).

The rate is $18.50 hourly during the day or $6.00 hourly from 6:00 P.M. to 8:00 A.M. and on weekends, plus $4.95 a month.

This is the initial log-on procedure: Dial the 800 access number. Use local echo (set your software to half duplex). When you connect, press Enter, type "HHH" and press Enter, and type "SIGNUP" and press Enter. Follow the prompts.

OFFICIAL AIRLINE GUIDE

The Official Airline Guide (OAG) provides schedules and reservations for 600 airlines and major hotels. Typically, you access OAG through another service. From CompuServe, type "GO OAG" and Enter. From MCI Mail, type "DOWJONES" and press Enter, then type "//OAG" and press Enter.

800-323-4000	Customer service/help.
01-930-2915	Customer service/help (Europe).

In the U.S., customer service hours on weekdays are from 7:45 A.M. to midnight; on weekends, the hours are 10 00 A.M. to 11:00 P.M.

Here are the OAG commands:

Command	Description
/S	View airline schedule information.
/F	View airline fare information.
/C	Cancel a reservation.
/H	View hotel/lodging information.
/I	Call up on-line information (help).
B	Reserve (book) a flight.
X	View expanded hotel/lodging information.
MM	Return to the OAG main menu.
OFF	Leave OAG; return to primary service.
/SFrom;ToDate	Quick schedule query format.
/SLAX;NYC12APR6A	Sample schedule query.

OAG normally steps you through a query one question at a time. Save time by entering one-line queries. Type (with no spaces) "/S" for schedule information, then the city or airport you're leaving from, a semicolon, the city or airport you're flying to, the date and month (in DDMMM format), and then the earliest time you want to leave (for instance, 6A, 10:30A, 1:45P, or 1930). Then press Enter. For fares, follow the same format after the /F command.

Enter departure and arrival times in effect at the airport, not from where you're calling. Use either the city name, the airport name, or the airport code to specify the city or airport you want. The city name may cover several airports. OAG accepts several city names; for example, "New York City" and "NYC" both work.

EAASY SABRE

The Eaasy Sabre service is run by American Airlines. It provides airline, hotel, and rental-car information and reservations, and is typically accessed through another communications service such as CompuServe. 800-331-2690 is the phone number for the help desk (voice).

Command	Description
Help or ?	View help (from any prompt).
Res or /R	View reservations menu.
Top or /T	View main menu.
Exit or /E	Exit to main on-line service.
/AIR,FROM,TO,DATE, TIME,CLASS	Quick entry (airline).
/HOT,CITY,ARRIVE, DEPART,#GUESTS	Quick entry (hotel).
/CAR,CITY,ARRIVE, DEPART,COMPANY	Quick entry (car rental).

You can follow the menu prompts to find a schedule or fare, or use a one-line quick-entry method called Faasttrack. To enter a query quickly: Type "/AIR", "/HOT", or "/CAR" for airline, hotel, or car information, respectively. Use commas to separate the parts of your query (no spaces). Type the airport code or city you're departing from, the city you're flying to, the date (in DDMMM format), the earliest acceptable departure time (followed by an "A" for A.M. or "P" for P.M.), and the class of travel you want. Then press Enter. For hotel or car reservations, enter the dates of arrival and departure, followed by the number of guests or the name of the car rental company.

Eaasy Sabre has look-up tables for airline fare classes and car rental companies. Economy class is A. If you don't know the airport or city name exactly, guess; you'll be shown a list of the closest matches.

Eaasy Sabre has no surcharge, but you will need an ID number—your American Advantage (frequent-flier) number. If you don't have an Advantage number, one is issued immediately; you choose the password.

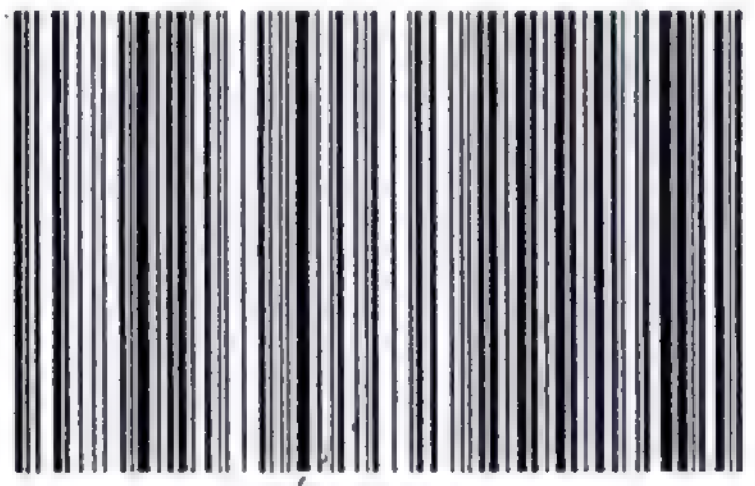
DOW JONES NEWS/RETRIEVAL

Most users access Dow Jones News/Retrieval through another service, such as MCI Mail. The access command is one of the menu items, or you can type "DOWJONES" or "GO DOWJONES". The Help phone number (voice) is 609-452-1511. Dow Jones commands are preceded by two slashes ("//").

Command	Description
//MENU	View master menu.
//DJHELP	View general help.
//[Topic] HELP	View help on a topic.
//NEWS	View recent news.
//DJNEWS	View recent business news.
//SYMBOL	Find a stock ticker symbol.
//CQ	Get a current stock quote.
//DEFINE	View definitions of financial terms.
//FYI	View customer information
//DISC	Exit Dow Jones.

Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side

Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

MCI Mail in Alaska and Guam (Tymnet)

Dial Tymnet, type "A" (don't press Enter), type "MCIMAIL", press Enter, and type your user name and password. You may need to use the Tymnet carrier in remote parts of the U.S. and its possessions. To find Tymnet numbers, type "HELP PHONES" and enter the state or territory. Tymnet access costs 25 cents a minute.

MCI Mail in Canada (Datapac)

Dial Datapac's local number, type ".." (two periods) and press Enter, type "13106" and press Enter, and type "MCIMAILUSA" and press Enter. To get Canadian access numbers, log on to MCI (before you travel to Canada) and type "HELP PHONES ONTARIO" (for example). Two 2,400-bps phone numbers are 416-979-1619 (Toronto) and 604-662-7732 (Vancouver). Or dial the California or Metro Washington toll number.

Lotus Express

If you use Lotus Express software, check these settings in the Communications Manager: If you have an error-correcting modem (MNP 5 or V.42), turn off X.PC error correction (set Protocol to None). For 9,600-bps access, the connection string should include: "AT\N3\Q1\X1Q0X1DT@nI{CONNECT}~I@m." Also set your terminal to 9,600 bps (Alt-Shift-X, F10, Terminal). If Express stops working, your in-box may be full (400 messages). If Express doesn't connect in the allotted time, add several commas at the end of the phone number, thus extending the time by 2 seconds per comma.

MCI Mail Fax Messages

You can send a fax from MCI Mail or mix fax and e-mail recipients. Here's a summary:

MCI prompt	Type
To:	John Doe (Fax) <Enter>
Country:	<Enter> (if U.S.A.)
Fax Number:	202-456-1414 <Enter>

Notes: You do have to type the area code, but don't type 1 for long distance. Don't type 9 if you're calling from a PBX (private branch exchange)

When sending faxes to Canada, parts of Mexico, or some Caribbean countries, you should use the area code but not the international dialing prefix, 011.

MCI International Access

To contact MCI from outside the United States or Canada, follow one of these steps: Use the U.S. toll numbers, subscribe to the country's PTT (for details, type VIEW INTERNATIONAL ACCESS), or use a local access number for the country (with a surcharge of 50 cents per minute). Most numbers are 2,400-bps MNP 5.

Miscellaneous MCI Mail Tips

Every command can be abbreviated to its first two characters: SC IN instead of SCAN INBOX, for example. Capitalization doesn't matter

To gang multiple commands on the Options line, separate them with commas.

You can find, read, or delete groups of messages by using SCAN, READ, PRINT, and DELETE, with the modifiers ALL, AFTER (date), BEFORE (date), DESK, FROM (name), INBOX, and ON (date). Examples: SCAN ALL ON 14-DEC, READ DESK AFTER 12/14, PRINT OUTBOX BEFORE DEC 14, and SCAN DESK FROM RUTHERFORD SUBJECT "SAN JOSE"

Messages remain in your DESK for five days Unread messages stay in your INBOX until read

If you send messages to the same persons repeatedly, CREATE LIST lets you use a shorthand "alias." For example, WCOAST could be a list of 25 people you access via a combination of MCI Mail, fax, CompuServe, and paper mail.

COMPUSERVE INFORMATION SERVICE

CompuServe Phone Numbers and Parameters

Phone number	Description
800-848-4480	800 access (1,200 or 2,400 bps).
800-331-7166	800 access (9,600 bps).
800-346-3247	Find local access number (by modem)
800-848-8990	Customer service.
614-457-8650	Customer service.
800-848-8199	Customer service (membership sales).
614-457-0802	Customer service (membership sales)
Comm settings	7 data bits, even parity, 1 stop bit, full duplex (7-E-1).

On weekdays, customer service hours are 8:00 A.M. to midnight; on weekends, 2:00 P.M. to midnight (Eastern time). To obtain your local access number by voice phone, call any customer service number during business hours and follow the prompts

The hourly rates are $6.30 (300 bps), $12.80 (1,200/2,400 bps), and $22.80 (9,600 bps), plus a user fee—generally $2 monthly. 800 access carries a $9 hourly surcharge; the surcharge rate varies for other access networks (Tymnet, Telenet, Datapac) For details on pricing, from the main CompuServe prompt type "CHOICES", then "RATES", then "BILLING"

Log-On Procedures

Find the appropriate local telephone number, or use one of the 800 access numbers. Set the communications parameters to 7-E-1. Dial the number and wait for the connection message, usually the word CONNECT or CONNECT/REL. Then follow the appropriate steps:

CompuServe Direct Access. Press Ctrl-C. When prompted, enter your user ID number and password. If the log-on didn't work and you see a prompt with the characters "UIC", press Ctrl-C and start over

Tymnet. You'll see garbled characters (or possibly "Enter your terminal identifier"). Type "A", but don't press Enter. At "Please log in:", type "CPS" and press Enter. Then type your ID and password.

Telenet. Press Enter twice. At the terminal identifier prompt, type "D1" and press Enter. At "@", type "C 614227" and press Enter. Then type your ID and password.

Datapac. Type one period for 300 bps or two periods for 2,400 bps. At the next prompt, type "P 29400138" and press Enter. At the host name prompt, type "CIS" and press Enter. Then type your user ID and password

Local Phone Numbers

Call one of the customer service numbers from a Touch-tone telephone and follow the prompts. Or, with a modem-equipped computer, dial 800-346-3247. When you're connected, at the "Host Name" prompt, type "PHONES" and press Enter; then follow the prompts. By entering your calling number, you let CompuServe determine what to suggest as the two best local phone numbers to use.

These are phone numbers for the largest U.S. cities (all 2,400 numbers are configured for 2,400, 1,200, and 300 bps)

City	Speed (bps)	Phone number
Anaheim, California	2,400	714-520-5231
	9,600	714-563-9431
Atlanta, Georgia	2,400	404-266-7060
	9,600	404-841-0578
Baltimore, Maryland	2,400	410-832-0160
	9,600	410-337-0026
Boston, Massachusetts	2,400	617-482-7061
	9,600	617-426-9295
Chicago, Illinois	2,400	312-263-5636
	2,400	312-693-0330
	9,600	312-201-0711
	9,600	312-693-4100
Cincinnati, Ohio	2,400	513-771-9543
	9,600	513-771-0592
Cleveland, Ohio	2,400	216-781-4135
	9,600	216-781-7598
Dallas, Texas	2,400	214-953-0436
	9,600	214-720-9183
Denver, Colorado	2,400	303-629-9145
	9,600	303-595-0123
Detroit, Michigan	2,400	313-535-1122
	9,600	313-535-1466
Houston, Texas	2,400	713-462-0923
	9,600	713-460-2705
Kansas City, Missouri	2,400	816-472-1283
	9,600	816-221-3817
Los Angeles, California	2,400	213-629-4095
	9,600	213-624-3730
Memphis, Tennessee	2,400	901-323-0220
	9,600	901-454-6851
Miami, Florida	2,400	305-262-1643
	9,600	305-262-9325
Minneapolis, Minnesota	2,400	612-339-2507
	9,600	612-339-1805
Newark, New Jersey	2,400	201-643-0404
	9,600	201-623-5666
New Orleans, Louisiana	2,400	504-733-2297
	9,600	504-733-3184
New York, New York	2,400	212-608-6021
	2,400	212-888-1020
	9,600	212-766-2080
Philadelphia, Pennsylvania	2,400	215-563-1305
	9,600	215-561-1634
Pittsburgh, Pennsylvania	2,400	412-261-4192
	9,600	412-471-6417

Command	Description
AT	Attention, modem, a command follows.
ATA	Answer the phone.
ATDT	Dial using tone dialing.
ATDP	Dial using pulse dialing.
ATH	Hang up the phone
A/	Repeat last command. This command does not begin with "AT" or end with <Enter>.
ATS0=2	Answer after *x* rings (here, 2 rings).
ATS0=0	Turn off auto-answer.
ATX0D	Force connection when manually dialing.
ATZ	Reset (zap) the modem.
,(comma)	Pause 2 seconds.
+++	Escape sequence; interrupts modem when on-line. Type "+++" quickly and wait for modem to respond "OK" Leaves on-line state (you're connected to another modem); goes to command state (you issue commands to your modem)
<Enter>	End command. On a line by itself while the modem is dialing or waiting for a connection, terminates dialing
Example:	"ATDT 9,1-202-456-1414 <Enter>" tone-dials an outside line, pauses 2 seconds, then dials the White House. The modem ignores the space after "ATDT" and the hyphens in the phone number

ELECTRONIC MAIL AND BULLETIN BOARDS

Here are basic instructions for major on-line services. Logging on may be more complicated from Canada or overseas. Check with the service of interest before you leave, and don't wait till the weekend or after business hours.

These commands work with many services, but not always through supplemental carriers such as Tymnet:

Command	Description
Ctrl-C	Interrupt remote computer
Ctrl-X	Delete line.
Ctrl-S	Stop scrolling display.
Ctrl-Q	Restart display (sometimes any key resumes).
Ctrl-H	Backspace and delete (sometimes Ctrl-W)

MCI MAIL

MCI Mail Phone Numbers

800 numbers are accessible from the United States and some parts of the Caribbean. Use toll numbers (Metro Washington, San Francisco) when calling from Canada or abroad if the local PTT (postal, telephone, and telegraph service) is a hassle. (Note that MCI now offers local access in 27 countries, in addition to access via PTT.)

X.PC is an error-correcting protocol supported by Lotus Express, The Norton Commander, and other MCI Mail LAN gateway programs. MNP 5 is the Microcom Network Protocol for data compression (and error control). Do not use both simultaneously; generally, you should disable X.PC.

To contact a user of another electronic service (CompuServe, Prodigy), consider Internet. Your Internet address is "*XXX-XXXX* [your MCI ID number] @ MCIMAIL.COM". For details, read MCI's bulletin boards (VIEW INTERNATIONAL) or help files (HELP AT&T or HELP COMPUSERVE).

Number	Description
800-234-6245	1,200 bps
800-456-6245	2,400 bps (MNP 5).
800-333-1818	2,400 bps (MNP 5 only).
800-967-9600	9,600 bps (MNP 5)
800-825-1515	Lotus Express and other software using X.PC.
703-769-0700	Metro Washington, D.C. (X.PC).
703-769-0750	Metro Washington, D.C. (MNP 5).
415-543-1500	San Francisco (X.PC).
415-543-6364	San Francisco (MNP 5).
800-444-6245	Voice help (9:00–8:00 Eastern time).
202-833-8484	Voice help (9:00–8:00 Eastern time).
Comm settings	8 data bits, no parity, 1 stop bit (8-N-1).

MCI Commands

These are the basic MCI commands. Type a command, or type "HELP" and the command name for details.

MCI command	Description
ACCOUNT	Set your MCI mailbox to fit your terminal and other custom options.
ANSWER	Reply to the sender of a message.
CREATE	Write a message.
DELETE	Delete messages in your MCI Mailbox.
DOWJONES	View Dow Jones News/Retrieval information
EDIT	Make changes to pending messages
EXIT	Leave MCI Mail (or END or QUIT)
FILES	View a complete listing of help files available from the command prompt.
FIND	Search for an MCI Mail subscriber's name
FIND EMS	Search for a particular LAN or gateway
FIND NAME	Search for an MCI Mail subscriber's name.
FORWARD	Forward a message to another person.
GLOSSARY	View a reference guide to commands.
INCLUDE	Insert text from other messages into yours
INDEX	List topics available to MCI Mail users
NEXT	Read the next message in your in-box.
PENDING	Retrieve a pending message
PRINT	Display messages nonstop (on-screen, not using a printer).
READ	Read messages a screenful at a time
SCAN	View a summary of your mail.
SEND	Send a message.
UPLOAD	Upload addresses from a PC onto an envelope.
/(slash)	Cancel command, message, or message recipient. Starting the last line of a message: ends message

MCI folder	Description
INBOX	Unread messages.
DESK	Read messages.
OUTBOX	Sent messages.
PENDING	Composed but unsent messages.
OUTBOX	Sent messages.
TRASH	Deleted messages.
ALL	All messages in all folders.

MCI Mail Command Basics

Here is a sample MCI Mail session. Press Enter if you don't understand an MCI prompt; MCI will skip the question if it's not required, or tell you what response it wants. Type "HELP" if you're confused. Type a slash (/) to cancel a message or designated recipient. Type "EXIT" to leave MCI Mail.

1. Dial the MCI connect number that matches your modem speed. Wait for "CONNECT". Wait another second and press Enter.

2. At "Please enter your user name:", type your user name (usually first initial, no space, last name). At "Password:", enter your eight-character password. Shortcut: At "Please enter your user name:", type your name, two slashes, and your password (no spaces).

3. MCI notifies you (for example), "Your INBOX has 7 messages" or "There are no messages waiting in your INBOX."

4. Type "SCAN INBOX" for summary information on each new message (sender, message subject, date). Note the number before each message (called the scan number). Turn on the capture-to-disk or capture-to-printer feature. Type "READ INBOX" to display all messages a screenful at a time. Type "READ 1, 3, 5–7" if you want to skip messages 2 and 4 at the moment (they remain in your INBOX) Type "PRINT INBOX" to print to the screen (not the printer), or type "PRINT 1, 3, 5–7".

To create a new message, reply to an existing message, or forward a message to someone else (most of the steps are similar):

1. Type "CREATE". Press Enter.

2. At "To:", type the recipient's name. You can type first and last name, first initial and last name, last name only, or MCI ID number. Press Enter. If the name is not unique, MCI presents a list of matches and asks you to pick one. If the user's name is common, type the name, a slash, and the user's city, state abbreviation, or company. Examples: "JGreenburg/Dallas", "BFullbright/MI", "TJones/Consolidated".

3. Add other recipients, one per "To:" line. Press Enter on a blank line when you're done.

4. At "CC:", add anyone you want to send a courtesy copy (CC recipients get the same message).

5. At "SUBJECT:", add a subject heading.

6. Type the message. You can use the Backspace key to make minor corrections. Ctrl-W backspaces and erases a single character; Ctrl-X erases the entire line. Press Enter at the end of each line (there's no automatic word-wrap). You can also upload and send a file created off-line, as long as each line ends with a carriage return.

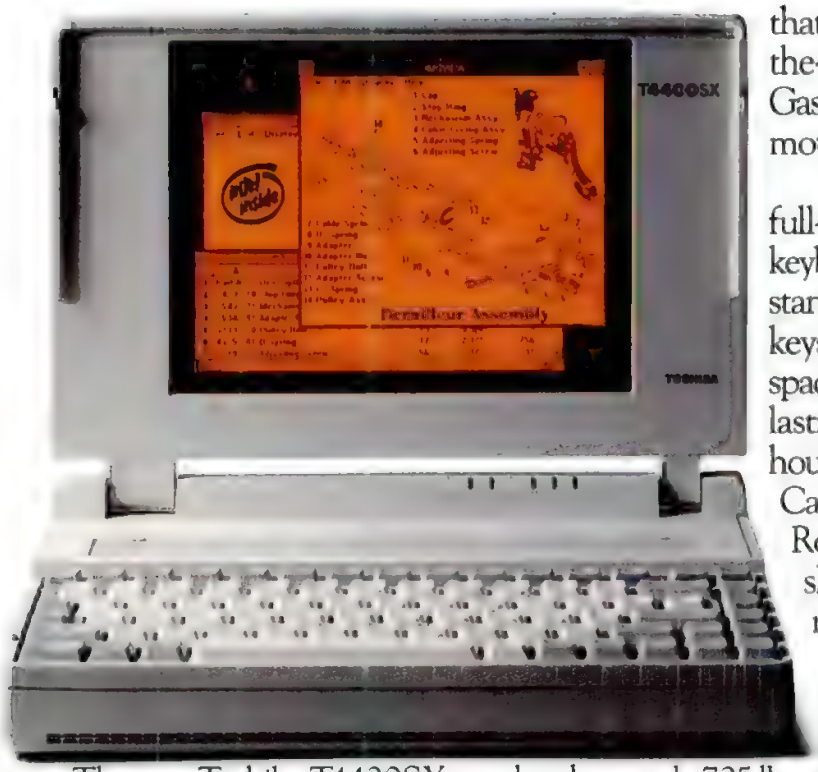
7. End with a slash (/) on a line by itself and press Enter.

8. At "Options:", you can type any of the following: "RECEIPT" (to be advised when the message is read), "PRIORITY: ONITE" (to tell the recipient you think your message is extra special, although it's not delivered any faster or slower), "DOC" (so that recipients don't see who else is receiving the message), or "CHARGE:" (to add a cost code that will show up on your MCI bill). Or just leave "Options:" blank.

9. At "Send?", answer yes or no. If you answer no, the message goes to your DRAFTS desk.

To answer a message: Type "ANSWER" to reply to the sender of the message you just read or "ANSWER EACH" to reply to everyone. Type "ANSWER 3 EACH" to reply to everyone who received message 3. To forward a message to someone else, type "FORWARD" or "FORWARD 3".

THE MOST POWERFUL 486SX. GOING.



The new Toshiba T4400SX notebook is the first 486SX computer that can offer all the power and performance of a desktop computer while freeing you from the tyranny of the nearest electrical outlet.

You can use our credit card-sized memory modules to expand standard 2MB RAM to 18MB for added speed and multitasking capabilities.

It offers a 25MHz 486SX microprocessor with 8K internal cache, which is upgradable to a full 486DX. Plus an 80 or 120MB hard drive and standard 2MB RAM expandable to 18MB.

The T4400SX is also the only notebook that offers, in addition to a state-of-the-art LCD display, a high-speed Gas Plasma screen which eliminates mouse blur.

If you choose the 9.5" diagonal LCD display, you get the versatility of 64 gray scales as well as high-resolution 640x480 VGA on the black and white ultra-thin screen.

You get a full-function keyboard with standard size keys and key spacing, a long-lasting 3.5-hour Nickel Cadmium battery and our Auto-Resume feature which lets you shut down and start up again right where you left off.

All in an ultra-strong 11.7" W x 8.3" D x 2.2" H carbon fiber-reinforced case weighing only 7.25 lbs. that fits into half a briefcase.

And on those occasions when you're actually at your desk, you can plug your T4400SX into our optional Desk Station IV with all standard desktop hardware connections and expandability.

If, after reading this, you'd like to know more about the T4400SX notebook computer, call us at 1-800-457-7777. We'll send you information that can lead to only one conclusion about desktop computers.

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CIRCLE 048 ON READER SERVICE CARD

The new T3300SL

maybe you should get into politics.

If your need for power is on the scale of say, Napoleon, consider the new T3300SL. It offers a 25MHz 386SL microprocessor plus 64 KB cache for blazing speed and longer battery life. Not to mention an 80 or 120MB drive and a PCMCIA-compatible slot. And like its cousin the T2200SX, it offers a Nickel Hydride battery and a carbon-fiber reinforced case. So call 1-800-457-7777. Or if you want even more power, don't forget it's an election year.

In Touch with Tomorrow
TOSHIBA

CIRCLE 050 ON READER SERVICE CARD

The award winning T2200SX

If you need any more power than this

If your desire for power is on the scale of say, Louis XIV, consider the Toshiba T2200SX. Weighing a mere 5.5 pounds and taking up just half a briefcase, it possesses an awesome 20 MHz 386SX microprocessor and a 40, 60 or 80 MB hard drive with 2MB RAM expandable to 10 MB. And it's powerful enough to have grabbed both a PC/Computing MVP award and a PC Magazine Technical Excellence Award.

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PRODIGY

Unlike most other services, Prodigy can be accessed only through proprietary software. If you want to use Prodigy right away, go to a computer or software store and buy the starter kit. Virtually all the help you'll need is in the Prodigy software; phone numbers are in the manual.

To use Prodigy, follow the instructions on-screen. There are five categories: Information, Living, Shopping, Finance, and Travel. Type "G" (for Guide) or press F5 to see where you are. Use the Tab key or a mouse to move around the screen, and press Enter or click the left mouse button to make a selection. You can also type plain-English commands at the bottom of the screen.

Command or number	Description
800-776-3449	Call for information and sign-up (voice).
800-759-8000	Call customer service (voice).
914-962-0310	Find local phone number (voice).
G or F5	View where-am-I guide.
Tab	Choose a command or option.
Enter	Execute the command.
JUMP, J, or F6	Jump (go) to another area.
I or F7	View alphabetical index.
MENU	View previous menu.
BACK or PgUp	View previous screen.
NEXT or PgDn	View next screen.
REVIEW	View list of the last 12 features accessed.

INTERNATIONAL VOLTAGE AND OUTLET PLUG GUIDE

To use your laptop overseas, you will probably need an adapter plug and a transformer. There are four basic adapter plug types that cover most of the world, and a fifth unique to Australia and New Zealand. These five plugs are illustrated below and labeled A, B, C, D, or E to correspond to the chart that follows.

Modern laptops are already fairly self-sufficient in handling foreign power sources. Most of the world uses 220-volt AC (actually, alternating current from 200 to 260 volts), while the United States, Canada, and much of Central and South America use 110-volt AC (100 to 160 volts). Most laptops are generally dual-voltage, meaning that their internal or external transformers automatically adapt to any voltage from 100 to 260. Also, although power overseas may be 50 Hz (cycles per second) instead of the 60 Hz common in North America, most dual-voltage transformers operate at both 50 and 60 Hz. However, a handful of countries use direct current (DC). If you encounter that situation, you'll need a DC-to-AC converter.

Following is an illustration of the five plug types and a chart that shows the voltages and outlet plug types used in foreign countries. A comprehensive database on international voltage and plugs is maintained by Franzus Co. Inc., Murtha Industrial Park, Beacon Falls, CT 06403; 203-723-6664; fax, 203-723-6666.

Sources *PC Magazine Guide to Notebook and Laptop Computers*, by Bill Howard, and *PC Magazine DOS 5 Techniques and Utilities*, by Jeff Prosise, both from Ziff-Davis Press, 1991. Additional research by Franzus Co. and *PC Magazine*.

International Voltage and Outlet Plug Guide

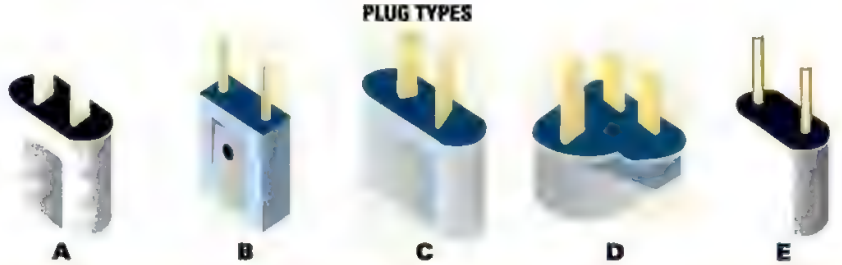
Country or region	Voltages available 110V	Voltages available 220V	Plug types
Afghanistan		●	B
Algeria	●	●	A, B, D
Angola		●	B
Antigua		●	D, E
Argentina *		●	D, E
Aruba	●		A
Australia	●		C
Azores	●	●	B
Bahamas	●		A, B
Bahrain		●	A
Bangladesh		●	B
Barbados	●		A
Belgium	●	●	A, B
Belize	●	●	A
Bermuda	●		A
Bolivia	●	●	A, B
Botswana		●	D, E
Brazil *	●	●	A, B, C, D, E
Bulgaria		●	B
Burma		●	D, E
Burundi		●	B
Cameroon	●	●	A, B
Canada	●		A
Central African Republic		●	B
Chad		●	B
Chile		●	B
China		●	B, C, E
Columbia	●		A
Costa Rica		●	A
Cyprus		●	D, E
Czechoslovakia		●	B
Denmark		●	B
Dominican Republic	●		A
Ecuador	●		A
Egypt		●	B
El Salvador	●		A
Ethiopia		●	B
Fiji		●	C
Finland		●	B
France		●	B
French Guiana		●	B
Gambia		●	D, E
Germany		●	B
Ghana		●	B, D, E
Gibraltar		●	D, E
Great Britain		●	D, E
Greece		●	D, E
Greenland		●	B
Grenada		●	B, D, E
Guatemala	●		A
Guinea		●	B
Guyana	●		A, B, D, E
Haiti	●		A
Honduras	●		A
Hong Kong		●	D, E
Hungary		●	B
Iceland		●	B
India *		●	B, D, E
Indonesia	●	●	A, B, E
Iraq		●	B
Ireland		●	D, E
Israel		●	B
Italy	●	●	B
Ivory Coast		●	B
Jamaica	●		A
Japan	●		A
Jordan		●	B
Kenya		●	D, E
Korea	●	●	A, B
Kuwait		●	B, D, E
Laos		●	B
Lebanon	●	●	B
Liberia	●		A
Libya	●	●	B
Luxembourg	●	●	B
Macao		●	B
Madeira *		●	B
Majorca	●	●	B
Malawi		●	D
Malaysia		●	D
Malta		●	D, E
Martinique		●	B
Nepal		●	B, E
Netherlands		●	B
Netherlands Antilles	●	●	A, B, D, E
New Caledonia & New Zealand		●	C
Nicaragua	●		A
Niger		●	B
Nigeria		●	D, E
Norway		●	B
Okinawa	●		A
Oman		●	D, E
Pakistan		●	B
Panama	●		A
Paraguay		●	B
Peru	●	●	A, B
Philippines	●	●	A, B
Poland		●	B
Portugal	●	●	B
Puerto Rico	●		A
Qatar		●	D, E
Romania		●	B
St. Lucia		●	D, E
St. Martin	●	●	A, B, D, E
Saudi Arabia		●	A, B, C, D, E
Scotland		●	D, E
Senegal	●		B
Seychelles		●	D, E
Singapore		●	D, E
South Africa *		●	D, E
Spain	●	●	A, B
Sri Lanka (Ceylon)		●	E
Sudan		●	B
Suriname	●		D, E
Swaziland		●	B
Sweden		●	B
Switzerland		●	B
Syria		●	B
Tahiti	●		A
Taiwan	●		A
Tanzania		●	D, E
Thailand		●	A, B
Trinidad	●	●	A, B, D, E
Tunisia	●	●	B
Turkey	●	●	B
Turks and Caicos Islands	●		A
Uganda		●	D
Upper Volta		●	B
Uruguay		●	D, E
U.S.A.	●		A
Former U.S.S.R.		●	B
Virgin Islands of the U.S.	●		A
Venezuela	●		A
Vietnam	●		A, B
Wales		●	D, E
Yemen		●	A, B
Yemen Arab Republic		●	B
Yugoslavia		●	B
Zaire		●	B
Zambia		●	D, E
Zimbabwe		●	D, E

* This country uses DC in some areas.

110 volts means 100–160 volts alternating current (AC).
220 volts means 200–260 volts.

Source: Franzus Co. Inc.

PLUG TYPES



FACT FILE

Micro Express NB2500 Notebook

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $2,925.
Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 9,600-bps fax modem, carrying case.
Options: 4MB RAM upgrade, $240; DOS 5.0, $65; external floppy disk drive, $299; math coprocessor, $199; external keyboard, $99.

497 ON READER SERVICE CARD

at slightly different prices, so check the fact files carefully. Blue Star Computers also offers a 130MB hard disk option that Micro Express doesn't support. Micro Express offers a 9,600-bps standard; the company does not sell the unit without it. Blue Star charges $225 for its fax modem.

Micro Express offers a 15-month warranty on parts and labor but covers its hard disks and floppy disk drives for only one year. An extended warranty costs 8 percent of the unit's price. Technical support and service calls come in on toll-free lines, 24 hours a day. Blue Star's warranty is for one year on parts and labor, and on-site service costs $59 extra. Blue Star also has an overnight swap service for replacing your damaged unit with a new one. Free technical support is available 24 hours a day, seven days a week.—*MAP*

Blue Star Computers Inc.

Blue Star 386SX/25 Notebook

Micro Express

Micro Express NB925

Microstar Computers Inc.

NoteStar NP-925 386SX/25

According to the FCC, the $2,277 NoteStar NP-925 386SX/25 originates in Taipei, Taiwan, where it is manufactured by Modern Computer. Indeed, Modern's notebook appears here in two other forms as well: the $2,199 Blue Star 386SX/25 Notebook and the $2,419 Micro Express NB925. These machines are reasonable though unspectacular values, with the Micro Express NB925 offering the end user just a bit more but for a higher price tag.

Micro Express NB925, Blue Star 386SX/25 Notebook, NoteStar NP-925 386SX/25

All three notebooks are cranked by an Intel 386SX 25-MHz processor and arrive carrying from 2MB to 8MB of RAM, a 130MB Toshiba MK2124FC hard disk, a Citizen 1.44MB floppy disk drive, a 10-inch diagonal Sanyo CCFT (cold-cathode fluorescent tube) LCD, all ports except a PS/2 mouse port, and an 84-key keyboard.

The NoteStar NP-925 can house a $175 coprocessor and a $186 9,600-bps fax modem. DOS 5 and Microsoft Windows 3.1 are standard, as is the one-year warranty on parts and labor. You may also want to spring $50 for the carrying case.

The Blue Star 386SX/25 arrives with a free carrying case. You can order an internal 9,600 bps fax modem for $225, a coprocessor for $150, and an external 1.2MB floppy disk drive for $249.

The Micro Express NB925 is basically the same system, except that its options include a $250 data modem ($350 for the fax-capable version), a $299 docking station, a $45 car battery adapter, and a $250 Ethernet adapter. Micro Express gives you a 15-month warranty on everything but the hard disk and floppy disk drives, which are covered for one year.

These units performed nearly identically on all our benchmark tests. Lack of a RAM cache resulted in average memory scores. The hard disks were identical and performed closely; video performance was slightly below average. Their battery test results were surprisingly different from the rest of the pack, however, since these three machines share a special trait: room for two nickel cadmium battery packs. On our Battery Rundown test, the Micro Express NB925 lasted 2 hours 56

SUITABILITY TO TASK

Blue Star 386SX/25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	●	○

SUITABILITY TO TASK

Micro Express NB925

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	●	○

SUITABILITY TO TASK

NoteStar NP-925 386SX/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

FACT FILE

Blue Star 386SX/25 Notebook

Blue Star Computers Inc., 2312 Central Ave. NE, Minneapolis, MN 55418; 800-950-8884, 612-788-5000; fax, 612-788-3442

List price (tested configuration): $2,199.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case.
Options: 4MB RAM upgrade, $289; with 130MB hard disk, $2,349; external floppy disk drive, $249; math coprocessor, $150; extra battery, $130; car battery adapter, $140; external pocket modem, $125.

502 ON READER SERVICE CARD

FACT FILE

Micro Express NB925

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $2,379.
Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case
Options: 2MB RAM upgrade, $120, 4MB RAM upgrade, $240; external floppy disk drive, $299; math coprocessor, $199; docking station, $299; extra battery, $99; car battery adapter, $45; Ethernet network adapter, $250, 2,400-bps modem, $250; 9,600-bps fax modem, $350

498 ON READER SERVICE CARD

minutes, the Blue Star 386SX/25 3 hours 3 minutes and the NoteStar NP-925 3 hours 9 minutes.

All have the same sturdy, slightly large case (1.8 by 12 by 9.5 inches) and weigh just under 8 pounds with the battery pack. Keys are almost full-size with good travel but wiggle from side to side a bit. The double battery packs located directly beneath the display are a great idea, but for some reason each awkwardly blocks one of the external expansion ports (one for the docking station and one for an external floppy disk drive). Still, the ability to accept external expansion in the form of a docking station makes this shared notebook one of the better choices for a desktop replacement. Lack of modem choices compromise good battery life—making all three poor Road Warriors.—*Oliver Rist*

FACT FILE

NoteStar NP-925 386SX/25

MicroStar Computers Inc., 35 Cotters Ln., Bldg. C1, East Brunswick, NJ 08816; 908-651-8686; fax, 908-651-0666

List price (tested configuration): $2,331
Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case
Options: 1MB RAM upgrade, $56; Microsoft Windows 3.1, $54, math coprocessor, $179; extra battery, $69, quick-charge battery adapter, $203, 9,600-bps fax modem, $186

499 ON READER SERVICE CARD

Bondwell Industrial Co. Inc.

Bondwell 386SL/F Notebook

Based on a 25-MHz Intel 386SL processor, the $2,699 Bondwell 386SL/F Notebook is a good machine at a fair price. The unit we tested posted some of the best times for a 25-MHz system on our processor and memory tests; regrettably, these were offset by a poor showing on our Battery Rundown and video tests. The Bondwell's external floppy disk drive means less weight to those would don't need the drive, so factor that into your buying decision. The NEC UltraLite III and the NCR System 3170 were the only other notebooks to detach their floppy disk drive this way.

The black Bondwell 386SL/F Notebook measures 1.5 by 11.5 by 8.5 inches and weighs 5.5 pounds with its nickel cadmium battery installed. Its 25-MHz low-power Intel 386SL processor was bolstered by a 16K four-way set-associative cache, which helped its performance. Our test model had 4MB of RAM (expandable to 8MB in 2MB increments), an 80MB Conner hard disk, an external floppy disk drive, a parallel and a serial port (but no mouse port), and an internal 2,400-bps modem. A Cirrus Logic GD610/620 chip set with 256K of video RAM controlled the 8.5-inch-diagonal Hitachi screen. While Bondwell Industrial Co. ships with DR DOS 6.0 preinstalled, we substituted DOS 5.0 for consistency in testing.

Bondwell 386SL/F Notebook

Helped by its processor RAM cache, the Bondwell led the pack in both processor and memory performance. Its Conner hard disk yielded average performance for this group, but its scores on the video and Graphics Winmark test were among the lowest. This poor performance makes the 386SL/F a poor system for Windows applications. The Bondwell's battery lasted 1 hour 37 minutes on our Battery Rundown test and 2 hours 3 minutes on the ZDigit Rundown test. Its battery performance was worse than that of most other machines we tested, and this compromised the system's Road Warrior suitability to task. Bondwell offers various software power-conservation options, but they don't seem to work as well as those of other machines.

SUITABILITY TO TASK

Bondwell 386SL/F Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	○	○	○

FACT FILE

Bondwell 386SL/F Notebook

Bondwell Industrial Co. Inc., 47485 Seabridge Dr., Fremont, CA 94538; 510-490-4300; fax, 510-490-5897

List price (tested configuration): $2,699
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB external floppy disk drive, DOS 5.0
Options: 2MB RAM upgrade, $299; 6MB RAM upgrade, $799, math coprocessor, $200, carrying case, $45

500 ON READER SERVICE CARD

The keyboard is small and cramped and lacks an inverted-T cursor-key arrangement, making this a poor desktop replacement. The external 3.5-inch floppy disk drive, which attaches on the left side in a proprietary slot, kept falling off, making it awkward to use on an airplane or in cramped surroundings. The body of the notebook itself seems sturdy enough to survive the abuse these portables often endure. One disadvantage, however, is that you can't change the battery on-the-fly.

The warranty covers parts and labor for one year, but you can buy an extended service contract from a third party. Bondwell offers free technical support in the continental U.S. via a toll-free number.—*Daniel A. Begun*

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CIRCLE 088 ON READER SERVICE CARD

Compaq LTE/Lite 20, Compaq LTE/Lite 25, Compaq LTE 386s/20

Compaq Computer Corp.

Compaq LTE Lite/25
Compaq LTE Lite/20
Compaq LTE 386s/20

The new Compaq LTE Lite/25 and Compaq LTE Lite/20 are state-of-the-art machines based on the Intel 386SL. Even the two-year-old Compaq LTE 386s/20, based on a 20-MHz Intel 386SX, is still only a notch or two behind. But with Compaq quality comes Compaq price: a fully loaded LTE Lite/25 costs over $4,000. And the new LTE Lites have compromised battery performance for lower weights.

The $4,199 Lite/25 and $3,999 Lite/20 share the same screen, keyboard, 6-pound weight, and 8.5- by 11- by 1.3-inch dimensions. The 386s/20 and the Lite/20 come standard with 2MB of memory, the Lite/25 with 4MB. All three can accept up to 10MB. You can choose one of three Conner hard disks: 40MB, 60MB, or 84MB. All three Compaqs were among the fastest performers on our processor and memory tests but dropped to midrange when it came to hard disk performance.

Unfortunately, a color version of the Lite/25 was not available in time to test it. The edgelit screens (9.5 inches diagonally on the Lite/20 and Lite/25 and a bit smaller on the LTE 386s/20) are sharp and crisp. You can run Windows and not lose much in translation to shades of gray. The Lites' new supertwist LCD, developed jointly with Citizen, reduces the "mouse trail" you see on the screen when you drag your mouse around. Its fast response carried over to our video test, where these three Compaqs were either best in class or close to it. The Lites permit simultaneous external display.

If your laptop pinch-hits as a desktop, you won't lack for connections. Except for the mouse port, which doubles as a keyboard connector, you have a full complement of ports. The Lite/25 comes with a nickel hydride battery; the Lite/20 has an enhanced nickel cadmium unit. But the batteries are interchangeable and can be used in either machine. The LTE 386s/20, slightly heavier at 7.8 pounds and larger at 8.5 by 11 by 2.3 inches, has a standard nickel cadmium battery.

On our Battery Rundown test, the two Lites lasted 2 hours 17 minutes; the LTE 386s/20's life was just shy of 3 hours. With power conservation enabled, their scores jumped to 3 hours 26 minutes for both Lites and 4 hours 7 minutes for the LTE 386s/20. The latter gets its boost from a larger battery: 1.8 pounds compared with the 1.3-pound battery in the Lite/20 and Lite/25. The battery recharge time for all three systems is 1 hour, or 1.5 hours when in the units are in use.

You can set power-down times for individual components and customize them to different applications. Besides a standby mode, the Lites have a hibernation mode that saves your current state to disk then powers down the machine, a feature that all notebooks should possess.

The keyboards have a short stroke and a very solid feel that users may take or leave. Although the function keys are noticeably small, the Lites have an inverted-T cursor-key layout—better than the L-shaped layout on the LTE 386s/20.

Compaq offers a wide variety of options, including a 9,600-bps data-only mo-

SUITABILITY TO TASK

Compaq LTE/Lite 25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Compaq LTE/Lite 20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

Compaq LTE 386s/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

FACT FILE

Compaq LTE Lite/25

List price (tested configuration): $4,199.

Tested Configuration: 4MB RAM, 84MB Compaq hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, $299; 4MB RAM upgrade, $799; 8MB RAM upgrade, $1,499; math coprocessor, $279; numeric keypad, $119; docking station, $929; battery charger, $99; AC power adapter, $149; car battery adapter, $99; 2,400-bps/send-fax modem, $319; 9,600-bps modem, $599; carrying case, $139.

Compaq LTE Lite/20

List price (tested configuration): $3,999.

Tested Configuration: 4MB RAM, 80MB Compaq hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.0.

Options: same as Compaq LTE Lite/25.

Compaq LTE 386s/20

List price (tested configuration): $4,099.

Tested Configuration: 4MB RAM, 30MB Compaq hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 1MB RAM upgrade, $349; 2MB RAM upgrade, $299; 4MB RAM upgrade, $1,499; DOS 5.0, $99; OS/2 2.0, $340; math coprocessor, $249; numeric keypad, $119; docking station, $929; battery charger, $149; AC power adapter, $199; car battery adapter, $129; 2,400-bps/send-fax modem, $319; 9,600-bps modem, $599; carrying case, $89.

Compaq Computer Corp., 20555 Farm Hwy. #249, Houston, TX 77070; 800-231-0900, 713-370-0670; fax, 713-374-1740

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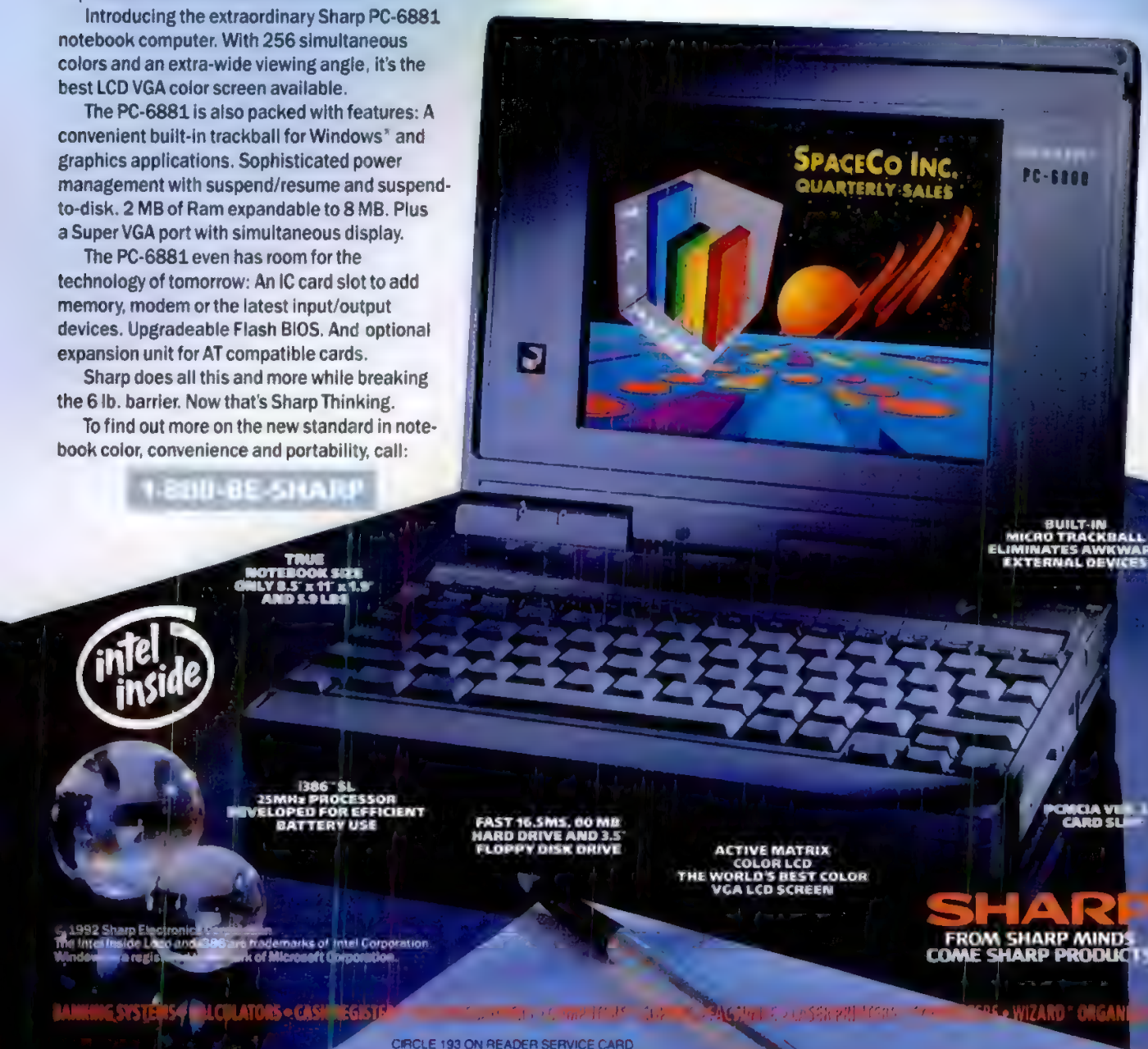

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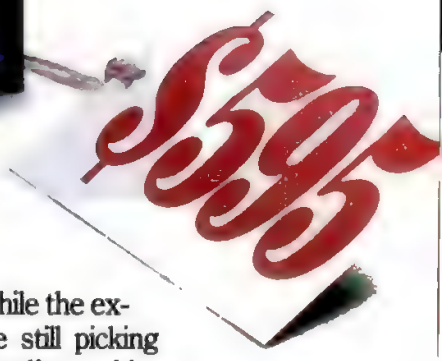
CIRCLE 193 ON READER SERVICE CARD

Confusing, Clunky, Costly.



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CIRCLE 361 ON READER SERVICE CARD

dem for its new notebooks, a must for people who need fast communications on the road. Compaq now offers one year of on-site service and support on all of its products, as well as a one-year warranty. Compaq has also added a toll-free support line open during business hours to supplement its traditional dealer-based service policies.—*Rick Ayre*

CompuAdd Express

CompuAdd Express 325NXL

Out of the box and into your briefcase, the CompuAdd Express 325NXL is a machine that will help you get your work done comfortably and at the right price. The sleek, gray, 2- by 11- by 8.5-inch 325NXL weighs a mere 5 pounds with its nickel cadmium battery; an included carrying case encourages you to take it wherever you go. But don't expect blazing performance.

Based on the 25-MHz Am386SX processor, CompuAdd Express's $2,095 325NXL comes standard with 4MB of memory (expandable to 16MB). Like many of 386/25 machines tested here, it lacks an external cache. Under the hood is a 62MB Western Digital hard disk, 1.44MB floppy disk drive, coprocessor slot, and 2,400-bps data/9,600-bps fax modem.

The Express 325NXL's performance was average on our processor, memory, and disk tests; however, the Western Digital WD90C22 video chip set turned in above-average results on both the video and Graphics Winmark tests. CompuAdd Express sent us DR DOS 6.0 with the system, but we performed our tests using DOS 5.0.

Power-management features are invoked via a driver in the CONFIG.SYS file. On our Battery Rundown test, the 325NXL gave us only 1 hour 40 minutes, which hurt the 325NXL's rating as a Road Warrior. But on our ZDigit Rundown test, the unit lasted nearly 5.5 hours—the third-highest score of the 70 systems tested with a battery in this issue.

SUITABILITY TO TASK

CompuAdd Express 325NXL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

A built-in trackball was difficult to get working at first, but proves useful and convenient under Windows. The trackball is placed at the bottom right of the keyboard; interestingly enough, the "trackball" buttons are located at the bottom left, between the Ctrl and Alt keys, so you must use a two-handed approach to point-and-click in Windows. The Lexmark keyboard is comfortable to use. Large and prominent function keys are ranged along the top, and the cursor keys are in an inverted-T layout just left of the trackball. Screen brightness and contrast are controlled by tiny, close buttons, which are set above the keyboard, not on the screen; you may hit them simultaneously until you're familiar with the layout. The AC adapter that you plug into the wall is huge and hefty; if you take it with you, it brings the total travel weight to 6.6 pounds. For service, CompuAdd Express offers a one-year warranty on parts and labor and toll-free technical support.—*Brad Grimes*

FACT FILE

CompuAdd Express 325NXL

CompuAdd Express, 12306 Technology Blvd., Austin, TX 78727; 800-925-3000, 512-219-1800; fax, 512-219-2890

List price (tested configuration): $2,095.

Tested Configuration: 4MB RAM, 60MB Western Digital hard disk, 1.44MB floppy disk drive, DR DOS 6.0, carrying case

Options: 8MB RAM upgrade, $300; math coprocessor, $139; extra battery, $29.95; extra AC power adapter, $10.95; AC adapter/charger, $89; IBM PS/2 keyboard adapter, $9

504 ON READER SERVICE CARD

Compudyne Products

Compudyne 486DX/33
Compudyne 386SXL/25

The $3,206 Compudyne 486DX/33 is one of only two 33-MHz 486DX notebooks in this roundup, the other being the $3,499 Tandy 4860 HD. Also, the company sells the inexpensive Compudyne 386SXL/25 for $1,806 in the same case. Both are solid, practical notebooks, but they lack the final touches to make them stand out from the crowd. Still, these price-conscious Compudyne cousins should prove a reliable choice.

The 5.9-pound Intel-based 486DX/33 lacks a processor RAM cache but comes with 4MB of RAM standard, expandable to 20MB. Our test unit had a 130MB Toshiba MK2124FC IDE hard disk (compared with the Tandy 4860 HD's 63MB unit) and a 1.44MB floppy disk drive, while the 6-pound Compudyne 386SXL/25 comes with a 60MB or 80MB Conner IDE hard disk. Both units have a 10-inch-diagonal Sharp-made screen powered by a Cirrus Logic GD640 chip set.

Of all the 486DX systems reviewed here, including the eight color portables reviewed in a separate section in this issue, the Compudyne 486DX/33 consistently placed among the top five on all our benchmark tests. Its battery life was a disappointment, however, averaging only 2 hours 12 minutes on our Battery Rundown test. We experienced some problems trying to test this portable with

SUITABILITY TO TASK

Compudyne 486DX/33

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

Compudyne 386SXL/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

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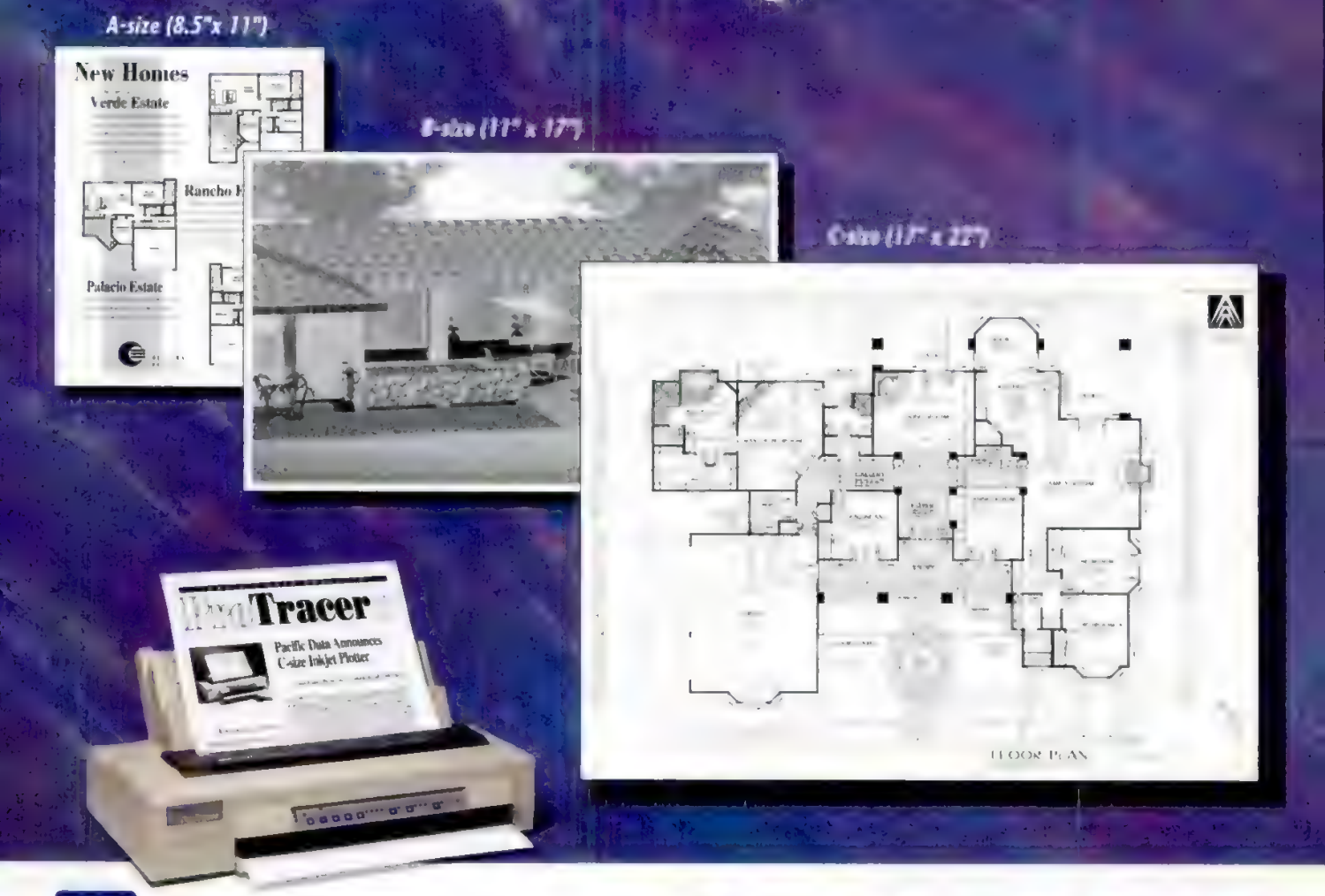

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power conservation enabled (see our sidebar "Battery Life vs. Portability" for more details. Though it offers user-adjustable power-management features and even a suspend/resume mode, the short life of its nickel cadmium batteries is difficult to ignore.

While the Compudyne 386SXL/25, based on the power-conserving Am386SX chip, turned in acceptable processor, memory, and disk scores, its Cirrus Logic GD640 video chip set earned an above-average grade on our video test. The battery life for its nickel cadmium batteries was also decent: 2 hours 44 minutes.

Both notebooks have a well-constructed feel and offer most of the features you would want. Made of a solid light-beige plastic and metal combination, the 1.8- by 11- by 8.5-inch case packs an equally solid 84-key keyboard. Behind a rugged rear door lies a full complement of ports, including an external video port that can pump out 800-by-600 resolution in 16 colors. Each unit contains an internal 1.44MB Epson floppy disk drive and a trackball mounted beneath the screen. This last feature, though nifty, is awkwardly placed for extended pointing and definitely requires two hands to use. Unfortunately, the keyboard features a noticeably short key travel, which may cause typos before you get used to it. Its ten functions keys are smaller than the rest, making for further finger fumbling.

Compudyne Products offers a small but complete variety of options, including a user-installable 9,600-bps fax modem and a docking station with one expansion slot and a 1.2MB floppy disk drive. The company warranties its products for one year on parts and labor; it also offers toll-free technical support.—*OR*

FACT FILE

Compudyne 486DX/33

List price (tested configuration): $3,208.

Tested Configuration: 8MB RAM, 130MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, PackRat.

Options: 2MB RAM upgrade, $105; 4MB RAM upgrade, $207; external floppy disk drive, $137; math coprocessor, $129; numeric keypad, $53; extra battery, $70; 2,400-bps/4,800-bps fax modem, $78; 9,600-bps fax modem with WinFax, $193; nylon carrying case, $39; leather carrying case, $115.

Compudyne 386SXL/25

List price (tested configuration): $1,806.

Tested Configuration: 6MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, PackRat.

Options: same as Compudyne 486DX/33.

Compudyne Products, 15151 Surveyor Blvd., Addison, TX 75244; 800-932-2667, 214-702-5600; fax, 214-702-0300

ON READER SERVICE CARD

Cumulus Corp.

Cumulus Express 386SX/20 Notebook

Our benchmark tests put the Cumulus Express 386SX/20 Notebook square in the middle of its processor class range. An average performer, nothing about this $2,299 notebook will raise an eyebrow; it's simply one of the crowd.

The off-white Cumulus Express measures 2 by 11 by 8.5 inches and weighs 6.5 pounds with its nickel cadmium battery. The Cumulus Express also includes a 1.44MB floppy disk drive and a full compliment of ports, including separate ones for a keyboard, mouse, and external floppy disk drive.

Our test unit, based on a 20-MHz Intel 386SX, came with 4MB of RAM and a 19-millisecond 60MB Western Digital hard disk with a 32K read-ahead buffer; DOS and Microsoft Windows 3.1 were preinstalled. RAM is user-expandable to 16MB in either 2MB or 4MB increments. Cirrus Logic makes the GD610/620 video chip set, and Hitachi makes the 9-inch-diagonal backlit VGA screen.

One of a large group of machines with no processor RAM cache, the Cumulus Express produced average results on all our tests except the battery test, on which it performed poorly. It lasted 1 hour 36 minutes on our Battery Rundown test and a mere 2 hours 18 minutes on our ZDigit

Rundown test. The Cumulus Express's main power-conservation feature is a time-out of Cumulus' screen backlight.

The keyboard seemed fragile, but its layout was sufficient, offering an inverted-T cursor-key layout and separate, dedicated Home, End, PgUp, and PgDn keys. Its general construction was fair, although the plastic parts tended to creak occasionally.

A short list of options now includes an internal 9,600-bps send-only fax, which has recently become available for $150. Cumulus offers a one-year parts-only warranty, but look for an extended service contract from your local dealer.—*DAB*

SUITABILITY TO TASK

Cumulus Express 386SX/20 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

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PC Magazine, Oct. 29, 1991

"...SX/Now! upgrades offer polish as well as good fit, performance and compatibility..."

PC Week, Aug. 26, 1991

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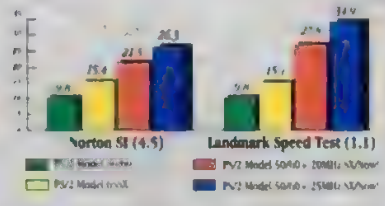

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CIRCLE 106 ON READER SERVICE CARD

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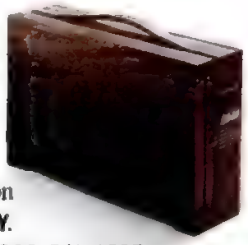

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CIRCLE 212 ON READER SERVICE CARD

FACT FILE

Cumulus Express 386SX/20 Notebook

Cumulus Corp., 23500 Mercantile Rd., Cleveland, OH 44122; 216-464-2211; fax, 216-464-2483

List price (tested configuration): $2,299
Tested Configuration: 4MB RAM, 60MB Western Digital hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, Microsoft Works, carrying case
Options: 2MB RAM upgrade, $100; extra battery, $100; 9,600-bps send-fax modem, $150

507 ON READER SERVICE CARD

Dauphin Technology Inc.

Dauphin 1050 Lapbook

Have a definite need for speedy video and Windows graphics? As one of the top video performers of this roundup, the 20-MHz Intel 386SX-based Dauphin 1050 Lapbook seems to be an excellent choice—until you realize that video is all it does well.

Dauphin Technology configured our $4,590 test unit with 4MB of DRAM (expandable to 8MB via SIMMs), a 124MB Toshiba hard disk, a 1.44MB floppy disk drive, and DR DOS 5.0. The ebony 2.3- by 12.5- by 11.2-inch 386SX/20 is bulky; weighing in at 7.6 pounds with its nickel cadmium battery installed, this is the one of the heavier notebooks we saw. The Dauphin has a detachable 9.5-inch-diagonal VGA-only screen, made by Seiko-Epson, that displays 32 shades of gray; it can run a 72-Hz VGA or Super VGA external display, but not simultaneously.

Dauphin 1050 Lapbook

SUITABILITY TO TASK

Dauphin 1050 Lapbook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

The Dauphin's performance on most of our benchmark tests was less than desirable, possibly due to the lack of an external RAM cache. This below-average performance and heavy system weight hurt the Dauphin's suitability to task ratings. The notebook's above-average video partially redeemed it: The Western Digital chip set placed the Dauphin high among 20-MHz systems on the video and Graphics Winmark tests.

With all power-conservation features disabled for the Battery Rundown test, this unit had one of the shortest battery lives of this roundup (1 hour 42 minutes). When we tested the notebook with periodic sleeps (and screen-blanking and disk-spinning enabled), its score of 2 hours 16 minutes proved to be equally disappointing. Users will have to make the most of this system's power-conservation features: trickle-charge, screen and hard disk time-outs, sleep and suspend modes, and CPU slowdown.

The unit's design has a few drawbacks. Its 79-key keyboard's four cursor keys are in a row instead of in an inverted T, and they double as Home, PgUp, PgDn, and End keys. When we tested the Dauphin, the power-adapter pin (which doesn't fit all the way inside the port) kept detaching itself. In addition, the display's disconnect button (located on its somewhat unsturdy "neck") was hard to move.

You can extend the standard one-year parts-and-labor warranty an additional year for 10 percent of the system cost. Tech support is free via an 800 number, and the manufacturer performs all servicing.—*Robin B. Bornstein*

FACT FILE

Dauphin 1050 Lapbook

Dauphin Technology Inc., 1125 East Saint Charles Rd., Lombard, IL 60148; 800-782-7922, 708-627-4004; fax, 708-627-7618

List price (tested configuration): $4,590
Tested Configuration: 4MB RAM, 124MB Toshiba hard disk, 1.44MB floppy disk drive, DR DOS 5.0, carrying case
Options: 4MB RAM upgrade, $495, external floppy disk drive, $295, math coprocessor, $295, expansion chassis, $1,195; one-slot expansion chassis, $295, extra battery, $95; battery charger, $125; AC power adapter, $65; 9,600-bps fax modem, $395, carrying case $75.

508 ON READER SERVICE CARD

Digital Equipment Corp.

DECpc 320P Notebook

At $2,245, the DECpc 320P Notebook is one of the less expensive notebooks in this review. But its average price corresponds to an average design, average suitability to task ratings, and below-average performance on our benchmark tests.

Digital Equipment Corp. sent us its 386SX/20 with 6MB of DRAM (expandable to 8MB via a RAM card), a 40MB Conner hard disk, a 1.44MB floppy disk drive, a 2,400-bps internal modem, DOS 5.0, and Microsoft Windows 3.1. The 1.7- by 10- by 12-inch beige case weighs 6.4 pounds with its nickel cadmium battery, making it one of the lighter notebooks we looked at. The notebook's 8.5-inch-diagonal VGA-only display from Sharp shows 16 shades of gray; you can connect it to an external 60-Hz VGA monitor, but you can't run both displays simultaneously. Because the display hinges near the center of the DECpc 320P, it gives you added room to angle the display when you're working in cramped conditions.

The DECpc 320P's performance on PC Magazine Labs' tests ranged from lackluster to subpar. This notebook did best on the disk test, where it turned in an average score. On the other tests, the

PowerBook 170: Apple's Power Portable

by Lori Grunin

It seems almost criminal to compare the Apple PowerBook 170—the top of Apple's three-machine line of portables—to the 25-MHz 386-based laptops that are its main competitors in the DOS world. At $4,599 for a 25-MHz 68030-based machine with a math coprocessor, 40MB hard disk, 4MB of RAM, PC-compatible 3.5-inch floppy disk drive (SuperDrive), monochrome active-matrix display, data/fax modem, and built-in trackball, the PowerBook 170 contains many of the portable world's best components.

After the disappointingly overpriced and oversized Mac Portable, it's no wonder that many Mac users have gone mobile with the PowerBook 170 and PowerBook 140 (6.8 pounds each) and the 5.1-pound PowerBook 100.

BUILT FOR GRAPHICS

The 2.3- by 11.3- by 9.3-inch (HWD) PowerBook 170 feels like a machine ergonomically designed to work with a GUI. The active-matrix display is beautifully crisp, and the relatively easy-to-manipulate trackball resides below the keyboard. The keyboard has been pushed a couple of inches forward toward the center hinge, leaving a section on which to rest your wrists while typing. The 170 also sports most of the interfaces that Mac users have come to appreciate—a built-in Apple Desktop bus port, two LocalTalk ports, a SCSI port, and audio in/out ports. It even comes with an external microphone, the Mac-standard Apple 8-bit sound chip, and a reasonable built-in speaker.

Apple didn't break any new ground with its battery, which is nickel cadmium. But the machine's architecture allows the Battery desk accessory to give you an automatic gas-gauge reading of your current battery level, both during charge and consumption.

SORTA DOES DOS

Many DOS users won't have the opportunity to appreciate the PowerBooks, though, despite Apple's claim that they run DOS. To do so, you must purchase SoftAT, a $499 package that emulates a 286-based machine with EGA graphics running MS-DOS 3.3 (Insignia Solutions, 526 Clyde Ave., Mountain View, CA 94043; 800-848-7677, 415-694-7600). Since Version 6.0 of PC Magazine Labs' Hardware

The PowerBook 170: Apple's Mac-to-go.

Performance Tests makes hardware-specific calls that SoftAT could not translate, we could not successfully test the PowerBook 170. But well-behaved applications (and even some not-so-well-behaved ones, such as XyWrite) seemed to run—but very slowly. Version 5.6 of PC Labs' benchmark tests indicates that the PowerBook 170 emulates a 286 running at 11.8 MHz, although in all cases it tested and felt much slower. The battery life during normal use was approximately 2 hours.

The machine is hardly perfect. The keyboard is the traditionally jiggly Mac keyboard, with linear cursor keys (as opposed to an inverted-T) and no function keys. Also, the home-row locator bumps are on the *k* and *d* keys (the Mac standard) rather than on the *f* and *j* keys (the PC standard)—something that may throw you from time to time.

With prices starting at $1,599 for the PowerBook 100 (16-MHz 6HC000), $2,999 for the PowerBook 140 (16-MHz 68030), and $4,299 for the PowerBook 170 (25-MHz 68030), PC users will hardly start discarding their Toshibas or Compaqs. Still, it looks like Apple has successfully inspired another case of Mac envy.

Apple PowerBook 170
Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014; 800-776-2333, 408-974-1490
List price (tested configuration): *$4,599.*
Tested configuration: *4MB RAM, 40MB hard disk, System 7.0.1, 3.5-inch floppy disk drive (SuperDrive), math coprocessor, AC power adapter, 9,600-bps data/fax modem.*
Options: *2MB RAM upgrade, $299; 4MB RAM upgrade, $549; extra battery, $89; battery charger, $99; SCSI system cable, $44; Apple Desktop bus mouse, $99.*
Circle 508 on reader service card

DECpc 320P's results were below-average: Its Cirrus Logic GD610/620 chip was near the bottom of the 20-MHz class on the video and Graphics Winmark tests. Similarly, it placed in the bottom fifth on the processor test and well below-average on the memory test, possibly due to the lack of an external cache.

With power conservation disabled, the DECpc 320P lasted 2 hours 9 minutes on our Battery Rundown test. With periodic sleeps, screen-blanking, and disk-spinning enabled, it lasted 3 hours 26 minutes. Power-conservation features include hibernation/deep sleep; suspend/resume; and standby display, VRAM, and hard disk time-outs. You can trickle-charge the battery or change it on the fly.

User-friendly features help to compensate for this system's poor performance. The standard 84-key keyboard has an inverted-T cursor-key layout and dedicated Home, End, PgUp, and PgDn keys. In order to turn the unit on or off, you have to depress the power key for about 1 second, making it almost impossible to turn the unit off accidentally. An LED outside the case lets you know if the system is on, even when the notebook is closed.

You can extend the standard one-year

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CIRCLE 167 ON READER SERVICE CARD

SUITABILITY TO TASK

DECpc 320P Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

DECpc 320P Notebook

Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 800-722-9332; fax, 508-486-6422

List price (tested configuration): $2,245.
Tested Configuration: 6MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, vinyl carrying case.
Options: 2MB RAM upgrade, $200; upgrade to 80MB hard disk, $500; math coprocessor, $195; external keyboard, $50; extra battery, $85; AC power adapter, $100; Ethernet pocket network adapter, $405; 9,600-bps modem, $200; leather carrying case, $150.

360 ON READER SERVICE CARD

parts-and-labor warranty for an additional year for $210 or for 2 years at $400. Technical support is on a toll-free line, and the manufacturer performs all servicing. —*RBB*

Dell Computer Corp.

Dell System 325N
Dell System NL25

You won't go wrong buying either of Dell Computer Corp.'s solidly designed 25-MHz offerings. The $2,698 Dell System 325N delivers good performance at a middling price. The $2,626 Dell System NL25's bottom-of-the-heap video performance might put it out of the running for Windows applications, but its relatively low base price (Dell's pricing starts at $2,098) makes it a good buy for all other applications.

Both machines use an Intel 386SL processor and are housed in dark-gray cases. The System 325N weighs in at 6.4 pounds; the System NL25 at 6.3. The System NL25's case is a slightly trimmer 1.8 by 8.3 by 11 inches, compared with the System 325N's 2.1 by 8.5 by 11 inches. Our

Dell System 325N, Dell System NL25

evaluation configuration for the System 325N included a 60MB 19-millisecond Conner hard disk and a 1.44MB floppy disk drive located to the right of the 85-key keyboard. The System NL25 held an 80MB hard disk, its largest possible capacity. Each unit came with 4MB of RAM. The System 325N allows expansion up to 12MB, but the System NL25 allows a maximum of only 8MB.

Each system also uses a 9.5-inch-diagonal Sharp VGA TSTN (triple supertwisted nematic) edgelit LCD screen, but with different video chip sets. The System 325N uses the fast Western Digital 90C22/90C55, while the System NL25 uses the Cirrus Logic GD610/620, which runs a disappointing 500 operations per second slower. Both units can drive an external monitor at 800- by-600 resolution with 16 colors. The System 325N's 64K cache also seemed to give it a slight memory-performance edge over the System NL25, which only has 16K, but both units landed in the top third of their class.

The two machines' battery technologies are also different, although they both have a plethora of power-management options. The System 325N uses the same nickel hydride battery as the Dell's color System 325NC: It lasted a respectable 3 hours on our Battery Rundown test and a strong 5 hours on our ZDigit test. The System NL25's nickel cadmium battery lasted only about 2.5 and 3.5 hours, respectively, on the same tests.

SUITABILITY TO TASK

Dell System 325N

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

Dell System NL25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

PC MAGAZINE EDITORS' CHOICE

Dell System 325N

List price (tested configuration): $2,698.
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, BallPoint Mouse.
Options: 2MB RAM upgrade, $179; 4MB RAM upgrade, $329; 8MB RAM upgrade, $599; math coprocessor, $199; numeric keypad, $149; extra battery, $169; battery charger, $269; car battery adapter, $129; DOS 5.0, Microsoft Windows 3.1, mouse, $149; DOS 5.0, Microsoft Windows 3.1, BallPoint Mouse, $199; Ethernet pocket network adapter, $399; Token-Ring network adapter, $595; 9,600-bps, MNP 4 or MNP 5 fax modem, $149; 9,600-bps fax modem, $299; 9,600-bps (V.32bis, V.42, or V.42bis) data/fax modem, $599; leather carrying case, $99.

Dell System NL25

List price (tested configuration): $2,626.
Tested Configuration: 4MB RAM, 80MB hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse, carrying case.
Options: 2MB RAM upgrade, $179; 4MB RAM upgrade, $379; 8MB RAM upgrade, $537; math coprocessor, $199; numeric keypad, $79; extra battery, $69; Ethernet pocket network adapter, $399; Token-Ring network adapter, $599; 9,600-bps send-fax modem, $149; leather carrying case, $99.

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-289-3355, 512-338-4400; fax, 512-338-8700

516 ON READER SERVICE CARD

SOME PEOPLE THINK 486 LOCAL BUS COMPUTERS ARE BRAND NEW AND COST ALOT.

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- 1MB VGA Palette Plus Card
- Slimline Dual Floppy Drive
- Swan Mouse & pad
- Windows Bundle, DOS 5.0

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- Intel 386DX-33 System
- 4MB RAM, 64K Cache Memory
- 60MB 16ms IDE Drive
- 12" Mono Monitor
- 5.25" and 3.5" Floppies

$1585

SWAN EXPRESS

- 4MB RAM, 50MB 17ms IDE Drive
- VGA (1024 x 768) Monitor
- 1MB VGA Palette Plus Card
- Slimline Dual Floppy Drive
- Swan Mouse & pad
- Windows Bundle, DOS 5.0

$2145

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SWAN 486/33E

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- 120MB 17ms IDE Drive
- 8) 32-bit EISA Expansion Slots: 6 Bus Masters, 2 Bus Slaves
- 12" Mono Monitor
- 5.25" and 3.5" Floppies

$2735

SWAN 386/25

- Intel 80386DX-25 System
- 1MB RAM, 60MB 16ms IDE Drive
- 12" Mono Monitor
- 5.25" or 3.5" Floppy

$1185

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CIRCLE 104 ON READER SERVICE CARD

Both machines use the same firm-feeling, generally well-laid-out keyboard (although it's too easy to hit Home instead of Backspace). The System NL25 has labeled function keys for getting into power-management setup, reversing the screen, and toggling between the external and internal displays. While most of the same functions are available on the System 325N, the keys are not labeled.

Dell offers a wide range of options and backs the systems with a one-year parts-and-labor warranty; on-site service and replacement for the System 325N, factory service and replacement for the System NL25; and a free technical support line. Extended warranties are available at an extra cost.—*Lori Grunin*

Epson America Inc.

Epson NB-SL/25
Epson NB-SL/20

Epson NB-SL/25, Epson NB-SL/20

Both the Epson NB-SL/25 ($3,627) and the Epson NB-SL/20 ($3,127) share a modular design that makes it remarkably easy to switch components: The RAM, hard disk, coprocessor, screen, and modem are all separate, easily replaceable units. The hard disk, for example, comes in a cartridge that you can pull out by unlocking two switches. This helps promote data security and makes it easy to share the laptop with coworkers who have their own hard disks. The modular design is also central to Epson America's Extra Care Road Service: The company ships a replacement module to you at no cost under the one-year warranty and encloses a prepaid airway bill for returning the original.

SUITABILITY TO TASK

Epson NB-SL/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Epson NB-SL/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	●	○

Each unit measures 2 by 11.5 by 9 inches. The NB-SL/25 weighs 7.2 pounds with its nickel cadmium battery, the NB-SL/20, 6.6 pounds. The NB-SL/25 is based on a low-power Intel 386SL-25/360 processor chip set. Our test unit had 6MB of RAM (4MB is standard), a removable 80MB Toshiba MK2024 IDE hard disk, and a 1.44MB floppy disk drive. One of Epson's newest options is a 9,600-bps data/fax modem for $649. Our test unit had DOS installed, but in general, DOS costs $129 extra.

The screen, a 9.5-inch edgelit TSTN (triple super-twisted nematic) LCD made by Hitachi, was very clear; it was driven by a Cirrus Logic CL-GD-6410 video chip set. The keyboard had an excellent layout and feel, with separate cursor, Home, End, PgUp, and PgDn keys.

The Intel processor chip set, with 64K of 25-nanosecond SRAM cache and four-way set-associative architecture, powered its way to the top of its class on our processor and memory tests; the note-book's video and hard disk performance was solidly average. Its battery life was 2 hours 17 minutes on our Battery Rundown test, and with power-management features enabled, the NB-SL/25's best time was 3 hours 39 minutes.

EPSON NB-SL/20

The Epson NB-SL/20 is based on a 20-MHz Intel 386SL processor; its 64K of direct-mapped write-back RAM cache helped it win top scores within the 20-MHz group on our processor and memory tests. The rest of the components, including the screen, were identical to those of the NB-SL/25. Unfortunately, opening the machine during testing revealed large amounts of hardwiring on the motherboard, which brings the system's durability into question.

As with its 25-MHz sibling, the NB-SL/20's performance on our video test was average, as was its hard disk score. Battery life on our Battery Rundown test was 2 hours 33 minutes; with power-saving features enabled, the NB-SL/20 lasted 3 hours 29 minutes.

Epson backs its notebooks with a standard one-year warranty on parts and labor, including overnight parts replacement under Epson's Extra Care Road Service policy. An extended service contract is available for $25 per year, with approximately 1,000 locations nationwide. On-site service is available through authorized Epson dealers.
—*Mario Baldasserini*

FACT FILE

Epson NB-SL/25

List price (tested configuration): $3,627.
Tested Configuration: 6MB RAM, 80MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0
Options: 2MB RAM upgrade, $199, 4MB RAM upgrade, $399, upgrade to 120MB removable hard disk, $1,040, external floppy disk drive, $299, external keyboard, $69, numeric keypad, $89, docking station, $749; extra battery, $59, 9,600-bps fax modem, $249; 9,600-bps data/fax modem, $649, carrying case, $69

Epson NB-SL/20

List price (tested configuration): $3,127
Tested Configuration: 4MB RAM, 80MB Epson hard disk, 1.44MB floppy disk drive, DOS 5.0
Options: same as Epson NB-SL/25

Epson America Inc., 20770 Madrona Ave., Torrance, CA 90503; 800-922-8911, 310-782-0770; fax, 310-782-5220

512 ON READER SERVICE CARD

Everex Systems Inc.

Everex Tempo Carrier 386SX/20

Everex Systems' 20-MHz Everex Tempo Carrier 386SX/20, an Intel 386SX-based notebook, is a sturdy system with a price tag that may keep your attention. For $3,195, Everex delivers 4MB of 80-nanosecond RAM, an 80MB hard disk from Toshiba, DOS 5.0, and Microsoft Windows 3.1.

The Tempo Carrier measures 1.8 by 8.5 by 11 inches and weighs 5.3 pounds with its nickel cadmium battery installed. Memory options range from 2MB to a vendor-installed maximum of 8MB RAM in 2MB SIMMs. The warranty is voided if the system's case is opened; since that's the only way to upgrade the memory, let Everex do it.

The system's black-and-white VGA display, manufactured by Sharp, measures 8.5 inches diagonally and uses a Chips & Technologies 8514/A chip set. Though easy on the eyes, the display turned in a slow time on our video test, with only a marginal improvement on the Graphics Winmark test.

The Tempo Carrier's processor result was on a par with those of other uncached systems, though its memory score was a bit below. Its 81MB Toshiba MK2024FC hard disk with a 32K buffer did not perform significantly different from the others. On the Battery Rundown test, it lasted 1 hour 46 minutes; fortunately, if you have some time between flights, you can recharge the battery in just 1.5 hours. Display and disk time-outs can be adjusted in system setup, as can the suspend/resume mode.

Users who want an inverted-T cursor-key layout will be sorely disappointed. The cursor keys are arranged in a row at the lower right-hand corner and double for Home, End, PgUp, and PgDn keys with the aid of a function key. This arrangement does no more harm than sending you a few lines or screens past where you wanted to end up, but it can grate on your nerves after a while. The unit's gray case with its Fleck Stone texture creates a feeling of durability that's entirely warranted.

Everex offers a standard one-year warranty on parts and labor, but no on-site service and no toll-free technical support. However, Everex will pay shipping both ways.—*William P. Flanagan*

SUITABILITY TO TASK

Everex Tempo Carrier 386SX/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

FACT FILE

Everex Tempo Carrier 386SX/20

Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 800-992-3839, 510-498-1111

List price (tested configuration): $3,195
Tested Configuration: 4MB RAM, 80MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case
Options: 2MB RAM upgrade, $299, math coprocessor, $199, extra battery, $110; AC power adapter, $149, 9,600-bps send-fax modem, $329

555 ON READER SERVICE CARD

Gateway 2000

Gateway Nomad 425DXL
Gateway Nomad 420SXL
Gateway Nomad 325SXL

Geared to low power consumption, Gateway 2000's Nomad line offers excellent battery life, light weight, quality performance, and a highly competitive price. All these factors, plus support and a docking station for a 9,600-bps modem, contribute to some of the highest ratings on a *PC Magazine*'s notebook suitability to task seen in this issue. But the effort to achieve low weight in the Nomad line is slightly offset by a flimsy construction.

All of the Nomads have the same-design case, measuring 2 by 11 by 8.5 inches, and weigh about 5.7 pounds with their nickel cadmium batteries, which are specially enhanced for long life. The $3,495 Gateway Nomad 425DXL is virtually identical to its $2,795, 20-MHz 486SX sibling, the Gateway Nomad 486SXL, in all respects but the processor: a 25-MHz Intel 486DX at the high end, a 20-MHz Intel 486SX just a notch lower. The $2,095 Gateway Nomad 325SXL uses a 25-MHz Am386SXL. Gateway's two SX-based systems prove to be the better values and must be considered by anyone who is looking for more but wants to carry less.

The three test units had many of the same components. The two 486-based units come with 4MB of RAM standard (20MB maximum), the 325SXL with 2MB (6MB maximum). All have an 80MB Conner hard disk, a front-mounted 1.44MB floppy disk drive, a 79-key keyboard, a full array of ports located on the left side, and an external expansion port

SUITABILITY TO TASK

Gateway Nomad 425DXL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Gateway Nomad 420SXL

Road warrior/communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Gateway Nomad 325SXL

Road warrior/communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

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CIRCLE 60 ON READER SERVICE CARD

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Introducing the first 486SX notebook with TFT color.

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Introducing the Toshiba T4400SXC. The first notebook to offer you all the power of a 486SX with all of the jaw-dropping possibilities of TFT LCD active matrix color.

Consider that with its active matrix Super VGA color screen, the T4400SXC can actually display a kaleidoscope of 256 simultaneous colors at a 640 x 480 pixel resolution.

Remarkably, these 256 colors can be drawn from a palette of 185,000 colors to give life to photographic images and color intensive presentations. It's enough to make your retina want to take a vacation.

Not to mention that each pixel on the screen is controlled by three individual transistors, ensuring perfect focus and color registration. The result is amazing clarity far superior to desktop monitors and a brighter, faster screen that far exceeds passive matrix LCD color screens.

Combined with a blazing 25MHz, 486SX microprocessor and 8K internal cache, it's powerful enough to handle your wildest visions.

Of course, you shouldn't be limited by the number of ideas you have either. Which is why the T4400SXC is equipped with a 120MB hard drive for plenty of storage. And 4MB of RAM expandable to 20MB.

And since ideas happen anywhere, any time, we've designed it to fit in half of a briefcase and given it a Nickel Cadmium battery that lasts 3 hours per charge.

Of course, there are times like payday when it is necessary for you to be in the office. Which is why we made our new notebook to be expandable with our Deskstation IV, giving you two expansion slots, and ports for external monitor and external keyboard.

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CIRCLE 379 ON READER SERVICE CARD

Gateway Nomad 420SXL, Gateway Nomad 425DXL, Gateway Nomad 325SXL

for a $698 docking station (with three ISA slots and three drive bays), DOS 5.0, and Microsoft Windows 3.1. All had the same screen: a 10-inch backlit Sharp LCD powered by a Cirrus video chip set that pumps out 800-by-600 or 1,204-by-768 resolution at a 60-Hz refresh rate through the external video port. There's room for a math coprocessor and a 9,600-bps internal data modem ($365) or a 4,800-bps send-fax modem ($135).

Battery life is where these systems shine. Conservation features are user-definable via an easily found setup program, and the battery times on our tests were exceptional. The Nomad 425DXL lasted 4 hours 5 minutes on our Battery Rundown test; with power-management features enabled, it lasted 5 hours 30 minutes. These numbers for the Nomad 420SXL were 3 hours 41 minutes and 4 hours 34 minutes, respectively; and for the Nomad 325SXL, 3 hours 34 minutes and 5 hours 41 minutes, respectively. Their performance on our other tests was consistent with comparable systems, with one exception. All three systems performed well under Windows, which is attributable to the Texas Instruments engineering that went into these systems.

A potential drawback was the case construction. Plastic doors and ports bent easily with normal handling. The unit's case could be stronger, but with proper care this shouldn't be a major concern. The keyboard was also disappointing. The keys are a nice size except for the function, cursor, and most other control keys, which are all half-height. All the keys wiggle, and key travel is extremely short.

The one-year parts-and-labor warranty and toll-free technical support combination is common to the entire Nomad tribe.—*OR*

FACT FILE

Gateway Nomad 425DXL

List price (tested configuration): $3,495

Tested Configuration: 4MB RAM, 128MB Seagate hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: 4MB RAM upgrade, $225, numeric keypad, $65, docking station, $698, extra battery, $65, SCSI adapter, $300, Ethernet network adapter, $375; Token-Ring network adapter, $700, 2,400-bps/4,800-bps send-fax modem, $135, 9,600-bps modem, $365, carrying case, $50

Gateway Nomad 420SXL

List price (tested configuration): $2,795

Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: same as Gateway Nomad 425DXL

Gateway Nomad 325SXL

List price (tested configuration): $2,095

Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0

Options: 2MB RAM upgrade, $100, math coprocessor, $150, numeric keypad, $65, docking station, $698, SCSI adapter, $300, Ethernet network adapter, $375, Token-Ring network adapter, $700, 9,600-bps modem, $365, 2,400-bps/4,800-bps send-fax modem, $135; Citizen PN48 printer, $380, carrying case, $50

Gateway 2000, 610 Gateway Dr., P.O. Box 2000, N. Sioux City, SD 57049-2000; 800-523-2000, 605-232-2000; fax, 605-232-2023

514 ON READER SERVICE CARD

Intelec Corp.

Halikan 386SX/20

What can you expect when a company's name appears nowhere on its product? Based on an uncached 20-MHz Intel 386SX, the $1,937 Halikan 386SX/20 delivers 4MB of RAM, an 80MB hard disk, a 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, and little else. Originally a Chaplet system, the unit is remarketed by Halikan and then by Intelec. With all the shuffling, however, no one has thought to improve the crawling processor performance.

The innocuous light-gray plastic case measures 2 by 11.5 by 8.5 inches and weighs 6.4 pounds with its nickel cadmium battery. Our test unit had a 19-millisecond 80MB Conner CP-2084 IDE hard disk with a 32K read-ahead buffer, and a Cirrus Logic GD610/620 chip set with 80-nanosecond RAM. The unit holds only up to 4MB of proprietary 60-ns DRAM.

Halikan 386SX/20

The Intelec crept into last place on both the processor and memory tests, despite the unit's 60-ns DRAM, which should be enough for quicker performance if system memory were architected better. Its Conner hard disk scored below identical Conner disks in other systems. But the Intelec did pick up average scores on our video and Graphics Winmark tests. Battery life was 1 hour 53 minutes on our Battery Rundown test, and a middling 2 hours 30 minutes with power conservation enabled. This anemic performance, combined with its lack of an internal modem, left the Halikan 386SX/20 generally unsuitable

SUITABILITY TO TASK

Halikan 386SX/20

	POOR	AVG.	EXCELLENT
Road warrior/communications	N/A		
DOS applications	●	●	○
Windows applications	●	●	○
Desktop replacement	●	○	○

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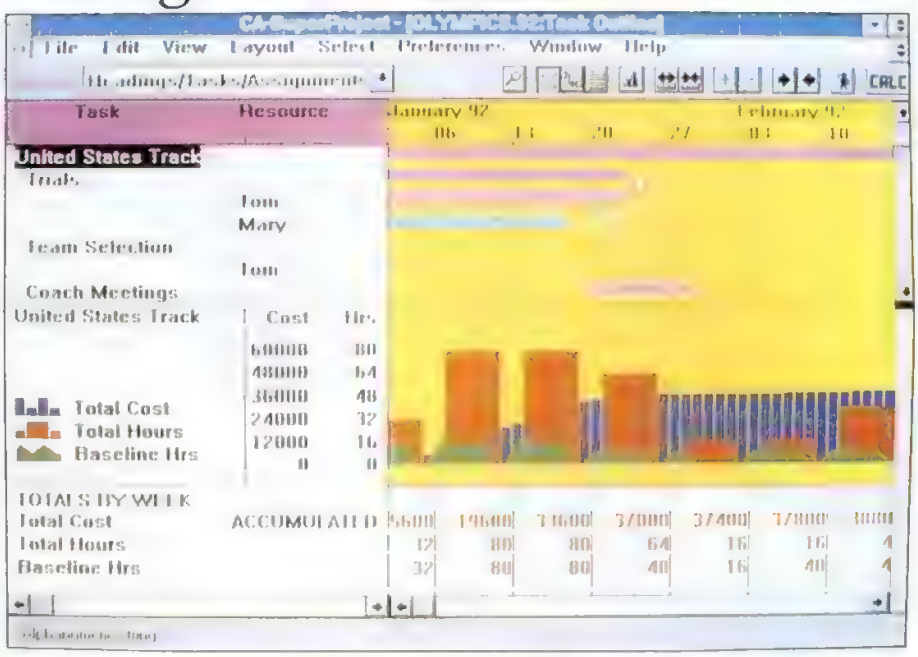

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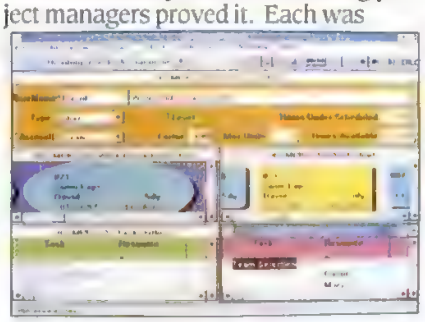

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CIRCLE 381 ON READER SERVICE CARD

FACT FILE

Halikan 386SX/20

Intelec Corp., 6075 NW 82nd. Ave., Miami, FL 33166; 800-683-096 9, 305-594-0001; fax, 305-477-9074

List price (tested configuration): $1,937
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5 0, Microsoft Windows 3.1, carrying case.
Options: 2MB RAM upgrade, $169; upgrade to 120MB hard disk, $289; math coprocessor, $159, docking station, $329; extra battery, $75; battery charger, $129; external pocket fax modem, $199

548 ON READER SERVICE CARD

for our four specified tasks.

The construction has its drawbacks: A narrow hinge connects the screen to the main unit; glimmers of metal show between the keys; cursor keys are set in an uncomfortable sideways L-shaped layout; and Home, End, PgUp, and PgDn are not dedicated keys. Finally, during testing, the unit's internal keyboard cable came loose and had to be reconnected.

Another strike against this system is the company's desire to be a black hole for phone messages; we had to call a number of times to get even basic information. Intelec offers a standard one-year parts-and-labor warranty; you can extend the service contract by two years for $350. You ship the unit in for repair and Intelec ships it back, usually within 48 hours. Technical support is toll-free, but we found the company's attitude less than helpful.—*Catherine Kunkemueller*

Identity Systems Technology Inc.

Identity 386SX/20 Notebook

If you expect something special from a unit with a relatively high price tag, the $3,495 Identity Systems 386SX/20 will leave you hanging; it's an average performer offering little else.

Identity 386SX/20 Notebook

Based on a 20-MHz Intel 386SX processor, the Identity measures 2.3 by 11 by 8.5 inches and weighs 6.4 pounds with its nickel cadmium battery. Our test unit held the notebook's 5MB maximum offering of 80-nanosecond DRAM, plus a 17-millisecond 130MB Toshiba MK2124FC hard disk with a 32K buffer, an Okidata 1.44MB floppy disk drive, and a 8.5-inch Sanyo LCD controlled by a Cirrus Logic GD610/620 chip set with 256K of 70-nanosecond video RAM. Also included in the system were an 80-key keyboard, DOS 5.0, and Microsoft Windows 3.1.

The Identity is configured similarly to most of the 20-MHz 386SX machines evaluated here, and, not surprisingly, it performed accordingly. Slowed by the lack of a processor RAM cache, it came in on the low side of the range on all of our tests except the disk test, where it was solidly midrange. Its battery life was unimpressive: 1 hour 45 minutes on our Battery Rundown test. Under conditions approximating those of normal use, the battery lasted 2 hours 18 minutes.

Though the Identity uses standard components, its construction suffers drawbacks, including a case that felt weak and a screen that was unattractive no matter how much you fiddled with its limited image controls. The notebook's mostly full-size keys wiggled, and the keyboard lacked an inverted-T cursor-key layout and separate Home, End, PgUp, and PgDn keys. Also, the power and contrast controls are on the right side of the case next to the floppy disk drive, which rules out using a right-handed BallPoint Mouse–type portable device. Though the AC brick was small and light, it lacked an indicator light, making battery recharging an unpleasant guessing game.

Identity Systems Technology offers a one-year parts-and-labor warranty and toll-free technical support. In this consumer-oriented age, however, the company's technical support personnel were surprisingly ineffectual. All this for almost $3,500? If you spring for it, you may be in for a whole new kind of Identity crisis.—*OR*

FACT FILE

Identity 386SX/20 Notebook

Identity Systems Technology Inc., 1347 Exchange Dr., Richardson, TX 75081; 800-723-8258; 214-235-3330; fax, 214-699-8404

List price (tested configuration): $3,495.
Tested Configuration: 5MB RAM, 124MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case.
Options: 4MB RAM upgrade, $474, external floppy disk drive, $199, math coprocessor, $195; extra battery, $79, external 9,600-bps MNP 5 fax modem, $279; wireless mouse, $119, leather carrying case, $59

534 ON READER SERVICE CARD

SUITABILITY TO TASK

Identity 386SX/20 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	N/A			
DOS applications	●	●		
Windows applications	●	●		
Desktop replacement	●	○		

Insight Computers

Insight 386-25SXL Notebook

The $1,949 Insight 386-25SXL Notebook, originally a Taiwanese OEM clone, closely resembles the Swan 386SX/25 Notebook. The difference is in the Insight's sub-$2,000 test configuration price. This price, combined with some useful design features and 25-MHz 386SX power, should be enough to entice bargain seekers willing to make some concessions.

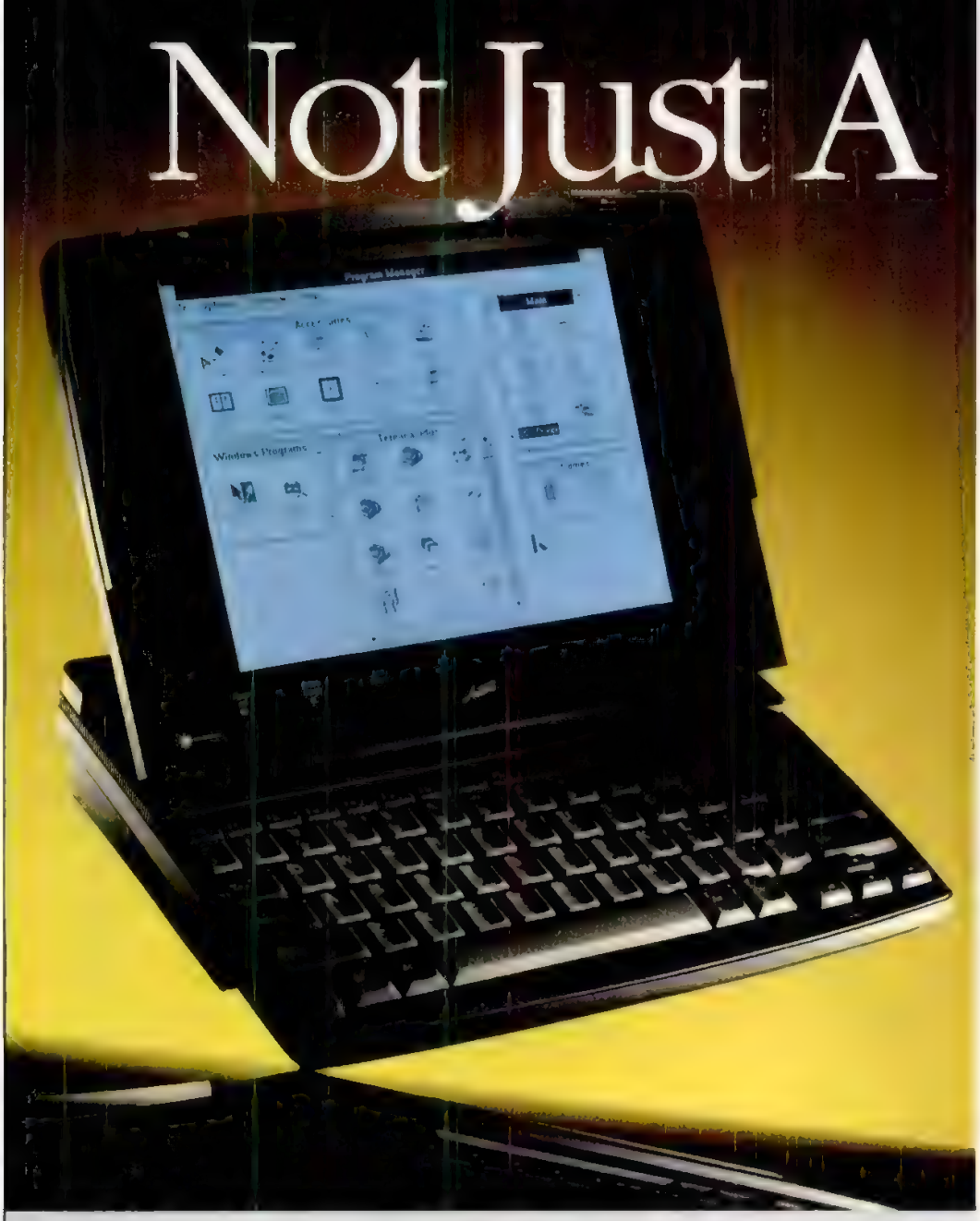
The Insight has an Am386SXL/25 processor without an external RAM cache; it measures 2 by 11 by 8.5 inches and weighs 5.7 pounds with its nickel cadmium battery. RAM ranges from 1MB to 8MB; our

SUITABILITY TO TASK

Insight 386-25SXL Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Not Just A 486.



Avanti 486

- 486 CPU runs the 486 instruction set for top performance
- Math Coprocessor blazes through floating point calculations
- On-Chip Cache retrieves critical data in four billionths of a second
- Advanced Power Management (APM) dramatically extends battery life
- Built-in Fax Send *and* Receive with Data Modem keeps you in touch on the road
- Patented Pivoting Screen lets you work in the tightest spaces
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- All the extras: MS-DOS 5.0, Windows 3.1, WinFax, Terminal Plus, Magic Cursor!, Mouse, and Carrying Case
- Designed, Engineered and Manufactured in the U.S.A

The new Avanti™ 486 is the perfect portable office. For reasons beyond its stunning looks.

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With its unique pivoting screen, you can use the Avanti in the tightest spaces - even an airplane tray table in coach (with the seat in front of you reclined!).

To make sure your first impression of the Avanti 486 is perfect, we've preloaded all the software on the hard disk - Windows 3.1, MS-DOS® 5.0, WinFax®, Terminal Plus™, and Magic Cursor!™ If needed, help is waiting on our toll free 800-number support line.

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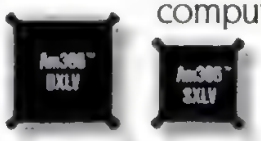

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With battery life of up to eight hours or more. That's a full day's worth of 386 performance—the per-

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And rest assured, the low-voltage Am386 microprocessors are proven compatible and comply fully with JEDEC standards for low-power, 3-volt computing. We can even supply you with the 3-volt EPROMs your systems will need. Other 3-volt system logic is also readily available.

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test unit came with 4MB of 80-nanosecond DRAM. You'll also get enough room for a coprocessor, an 85MB Toshiba hard disk (a 40MB or 60MB unit), a 1.44MB Toshiba floppy disk drive, a full complement of ports, and DOS 5.0. The screen is a 10-inch-diagonal Samsung LCD screen powered by a Cirrus Logic GD610/620 chip set with 256K of video RAM.

The Insight yielded scores on a par with its processor class on most of our benchmark tests, making it a system well suited for DOS applications, though it didn't do as well in terms of video. Its battery life could also use a shot in the arm: 1 hour 45 minutes on our Battery Rundown test and 2 hours 18 minutes on our ZDigit test. These poor battery results make the Insight only a so-so Road Warrior. To the notebook's credit, its small battery brick is easily installed and removed, and there are a wide variety of power-management features, including standby and sleep modes as well as power-saving time-outs for the LCD and hard disk.

The case construction, however, has some drawbacks. A large, slightly protruding front clasp feels weak and seems likely to break. The 80-key keyboard also feels frail, and the keys have short travel. Home, End, PgUp, and PgDn keys are combined with the cursor keys. In addition, the power connector port is inconveniently located behind the rear door, which hides the other interface ports. In other words, you must open the plastic rear panel to plug in AC power.

Insight Computers offers a one-year warranty on parts and labor; technical support is toll-free. Useful options include an upgrade to a 130MB hard disk for just $199, an external battery charger, and either a 2,400-bps internal modem or 9,600-bps fax.—*OR*

FACT FILE

Insight 386-25SXL Notebook

Insight Computers (a division of Insight Distribution Network Inc.), 1912 W. Fourth St., Tempe, AZ 85281; 800-755-9628, 602-350-1176; fax, 602-350-1182

List price (tested configuration): $1,949

Tested Configuration: 4MB RAM, 80MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse, carrying case

Options: 4MB RAM upgrade, $280, 6MB RAM upgrade, $429; upgrade to 130MB hard disk, $199; numeric keypad, $49; extra battery, $75; battery charger, $89; 2,400-bps modem, $125, 9,600-bps fax modem, $199; leather carrying case, $89

535 ON READER SERVICE CARD

KRIS Technologies

KRIS Master 386SX/25

If you're pining for a notebook based on AMD's low-power Am386SXL processor, the $1,795 KRIS Master 386SX/25

might be within your fiscal grasp. It has the lowest price among the 25-MHz 386s we tested here, and while its performance and suitability to task ratings won't win any awards, neither will they disappoint.

Our test unit, which fits up to 16MB of RAM, came with 4MB of 80-nanosecond DRAM, a 19-millisecond 80MB Toshiba IDE hard disk, a 1.44MB floppy disk drive, DOS 5.0, and Microsoft Windows 3.1. Its charcoal-gray plastic case measures 2 by 11 by 8.5 inches and weighs 6.7 pounds with its nickel cadmium battery. A Cirrus Logic GD610/620 chip set with 256K of 100-ns RAM controls the 9-inch Sharp screen.

SUITABILITY TO TASK

KRIS Master 386SX/25

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Lack of a RAM cache contributed to the unit's midrange processor, memory, and disk scores, while its score on the Graphics Winmark test was slow enough to discourage serious Windows users and drop its Windows apps suitability to task rating down to "fair"; DOS apps should run smoothly, though. Battery life was a reasonable 2 hours 41 minutes on our Battery Rundown test and 3 hours 11 minutes under conditions approximating normal use. The unit offers standby modes for the display (triggered by a button), the hard disk, and the CPU (configured during setup).

The Master 386SX/25's case, manufactured in Taiwan by the Full Power Investment Corp., is the same one used by the PC Brand 386SX/25, Poly Notebook 320T, and Positive PC32OND. The slightly clicky keyboard has an embedded numeric keypad, and labeled key combinations control the video display. The cursor keys are laid out in an inverted T but double for Home, End, PgUp, and PgDn with the aid of a function key.

KRIS Technologies offers a one-year

FACT FILE

KRIS Master 386SX/25

KRIS Technologies, 260 E. Grand Ave., S. San Francisco, CA 94080; 800-282-5747, 415-875-6729; fax, 415-877-8048

List price (tested configuration): $1,795

Tested Configuration: 4MB RAM, 80MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1

Options: 2MB RAM upgrade, $110, 4MB RAM upgrade, $330, 12MB RAM upgrade, $660, upgrade to 130MB hard disk, $170; math coprocessor, $175; external keyboard, $50, numeric keypad, $80, expansion chassis, $360, extra battery, $45, battery charger, $95, AC power adapter, $95, car battery adapter, $110; 2,400-bps modem, $165; 9,600-bps (MNP 5, V.42) fax modem, $335, leather carrying case, $125

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Data Compression Module *Double the size of your hard disk*

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Try finding another notebook with that much expandability! For office use, try the **ALR Ranger Station**. Just slide the Ranger M486 in, and instantly gain extra storage and three full-length ISA expansion slots.

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warranty on parts and labor through Dow Jones, an 800 number for service, and nationwide technical support. On-site service costs $79; extended warranties are available for case-tailored prices. Units shipped for repair are mirror-shipped back, usually within 24 hours.—*CK*

Matrix Digital

Matrix 386SX/20 Notebook

Mitsuba Corp.

Mitsuba Ninja 386SX/20

Packard Bell Electronics Inc.

Packard Bell 386SX/20 Notebook

The $1,949 Matrix 386SX/20 Notebook, $1,859 Mitsuba Ninja 386SX/20, and $1,999 Packard Bell 386SX/20 Notebook—all based on the uncached 20-MHz Intel 386SX processor—resembled each other on our tests as well as on our laps. But the triplets aren't identical. Quanta, a Taiwanese manufacturer, supplies much of the overall package, but each company claims to tweak it differently.

All three cases measure 2 by 8.5 by 11 inches and come in some variation of

Mitsuba Ninja 386SX/20, Matrix 386SX/20 Notebook, Packard Bell 386SX/20 Notebook

beige. The Matrix and Mitsuba each weigh 7.3 pounds with their "dynamite-stick" battery packs; the Packard Bell shaved off a few ounces to reach 7 pounds with battery. Past the first glance, differences emerge. The Mitsuba offers additional security, and the Packard Bell gives you another 20MB of hard disk space and Microsoft Windows 3.1, along with some nifty applications.

All our test units arrived with 4MB of RAM (but accept up to 8MB), have at least 60MB of hard disk space, a 1.44MB floppy disk drive, and DOS 5.0. All three use Cirrus Logic chip sets. Packard Bell Electronics claims to make its own screen; the others use screens from Sharp.

Differences in the hard disks are more interesting: Mitsuba Corp. says it has started shipping units with Conner's 2.5-inch hard disk in 60MB, 80MB, and 120MB configurations, though our test unit had a standard-size hard disk. By the time you read this, Mitsuba promises to eliminate the 60MB unit and start at 80MB for $1,859, but our fact file represents pricing as of June 1. For the present, Matrix Digital is staying with the Conner 3.5-inch hard disk in the same size range. Packard Bell offers only one model: the 80MB Toshiba hard disk.

Performance was solidly midrange on all of our tests, though battery life varied. All three allow battery swaps on the fly. The Mitsuba especially needs that feature: It lasted only 2 hours 2 minutes on our Battery Rundown test, though nearly twice that time (4 hours 7 minutes) with power-management enabled. The Packard Bell logged 2 hours 34 minutes on the Battery Rundown test and 3 hours 40 minutes with power-management enabled. The Matrix Digital lasted 3 hours 20 minutes on the Battery Rundown test and 4 hours 20 minutes with power-management features on. All three allow LCD power-down and standby modes.

Each machine has a password option that you can disable, but the Mitsuba does something truly interesting. If a user tries to gain access to the system without the password, the system locks down, and only Mitsuba intervention will cure it. This is a feature, not a bug: If the machine is stolen, your data is secure (and if the thief sends the machine to the company to be unlocked, it can easily be traced to its true owner by its serial number).

The keyboard in all cases is good. The keys are full-height and reside where you would expect them to be, though the inverted-T cursor-key block should be supplemented by separate Home, End, PgUp, and PgDn keys.

The systems are nearly identical in modem offerings as well, though prices vary. All three offer an internal 2,400-bps modem with 9,600-bps send-fax capabilities. Packard Bell includes the modem in its

SUITABILITY TO TASK

Matrix 386SX/20 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

SUITABILITY TO TASK

Mitsuba Ninja 386SX/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

SUITABILITY TO TASK

Packard Bell 386SX/20 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Matrix 386SX/20 Notebook

Matrix Digital, 1811 N. Keystone St., Burbank, CA 91504; 800-227-5723, 818-566-8567; fax, 818-566-1476

List price (tested configuration): $1,949.

Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, QuickLink II, carrying case.

Options: 2MB RAM upgrade, $149; 4MB RAM upgrade, $279; upgrade to 120MB hard disk, $189; Microsoft Windows 3.1 and mouse, $79; math coprocessor, $155; external keyboard, $49; expansion chassis, $439; extra battery, $70; 9,600-bps send-fax modem, $165.

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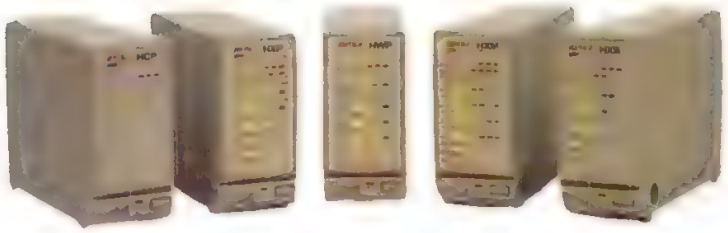

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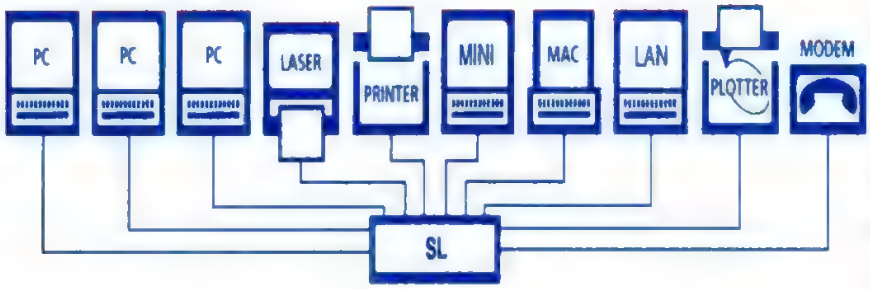

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HXM	2 Ser/ 2 Par	Any Combination	256KB-16MB	$295
HWP	5 Parallel	3/2, 4/1	256KB-16MB	$295
HXP	4 Parallel	2/2, 3/1	256KB-16MB	$245
HCP	2 Parallel	1/1	256KB-16MB	$225
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AS41	5 Parallel	4/1	None	$195
AS81S	9 Ser/ 1 Par	8/1	None	$79

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FACT FILE

Mitsuba Ninja 386SX/20
Mitsuba Corp., 1925 Wright Ave., La Verne, CA 91750; 800-648-7822, 714-392-2000; fax, 714-392-2021

List price (tested configuration): $1,859.
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, carrying case.
Options: 2MB RAM upgrade, $172; 4MB RAM upgrade, $300; with 80MB hard disk, $2,028; with 120MB hard disk, $2,206; math coprocessor, $182; external keyboard, $66; expansion chassis, $515; extra battery, $585; battery charger, $199; 9,600-bps fax modem, $175.
519 ON READER SERVICE CARD

FACT FILE

Packard Bell 386SX/20 Notebook
Packard Bell Electronics Inc., 9425 Canoga Ave., Chatsworth, CA 91311; 818-886-4600; fax, 818-773-9521

List price (tested configuration): $1,999.
Tested Configuration: 4MB RAM, 80MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, Lotus 1-2-3, Lotus Write for Windows, 9,600-bps send-fax modem.
Options: All options available through third-party vendors.
536 ON READER SERVICE CARD

base-priced package; Matrix charges $165, and Mitsuba sells its for $10 more.

All three companies offer one-year parts-and-labor warranties. Mitsuba's service is done in-house; Matrix and Packard Bell delegate service responsibilities to their dealers. Matrix is a step ahead of the others in offering toll-free technical support for lesser disasters.—*AG*

Micro Express

Micro Express NB913 Notebook PC

Using a case designed by Modern Computer of Taiwan, the Micro Express units incorporate the same highly modular design found in NoteStar and Tartan units. Almost but not quite identical to these machines, the Micro Express systems are uncomplicated and remarkably easy to configure. Besides a highly modular design that puts parts replacement in the user's hands, the $2,219 Micro Express NB913 Notebook PC has a nice range of features.

Micro Express NB913 Notebook PC

Propelled by a 20-MHz Am386SXL processor, it comes with 2MB to 8MB of 80-nanosecond RAM but no RAM cache. The 17-millisecond 124MB Toshiba MK2124FC hard disk also comes in 60MB, 80MB, or 120MB sizes. Other features include a 1.44MB Citizen floppy disk drive, all ports except PS/2-style mouse, DOS 5.0, Microsoft Windows 3.1, and a carrying case. The 10-inch backlit Sanyo screen is driven by a Chips & Technologies F82C456 video chip set with 256K of video RAM. Options include a $299 external 1.2MB floppy disk drive with a serial interface, a $199 math coprocessor (it doesn't support Weitek), a $99 battery, a $250 external Ethernet adapter, a $45 car battery adapter, and a $250 2,400-bit-per-second internal modem ($350 for a fax-capable version).

SUITABILITY TO TASK

Micro Express NB913 Notebook PC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

On our processor, memory, and disk tests, the 7.2-pound Micro Express NB913 scored within the high part of the average range; its video scores were a tad lower but still average. This translates to a good DOS notebook, but Windows performance will lag. Micro Express's twin nickel cadmium battery pack gave the unit excellent battery life: 3 hours 20 minutes on our Battery Rundown test and 4 hours 20 minutes with power saving enabled.

The 2- by 11.5- by 9.5-inch case is sturdy. Most keys are full-size but have little key travel and stiff resistance. Cursor keys are laid out in an inverted T; Home, End, PgUp, and PgDn keys are separate.

Micro Express warrants the hard disk and floppy disk drives for one year on parts and labor but covers the rest of the unit for 15 months. Replacement parts, shipped to the user, are easy to install. Technical support is toll-free.—*OR*

FACT FILE

Micro Express NB913 Notebook PC
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-989-9900, 714-852-1400; fax, 714-852-1225

List price (tested configuration): $2,169.
Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 3.3 or later, Microsoft Windows 3.0 or later, carrying case.
Options: 2MB RAM upgrade, $120; 4MB RAM upgrade, $240; external floppy disk drive, $299; math coprocessor, $199; docking station, $299; extra battery, $99; car battery adapter, $45; Ethernet network adapter, $250; 2,400-bps modem, $250; 9,600-bps fax modem, $350.
520 ON READER SERVICE CARD

MicroStar Computers Inc.

NoteStar NP-913 386SX/20

Is Jay Leno the same as Johnny Carson? Maybe not, but in terms of performance, MicroStar Computers' $2,166 NoteStar NP-913 386SX/20 is nearly identical not only to the $2,219 Micro Express NB913 Notebook PC but to the rest of the competition as well.

The main difference between the Micro Express NB913 and the NoteStar NP-913 is that the Micro Express NB913 runs

SUITABILITY TO TASK

NoteStar NP-913 386SX/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

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Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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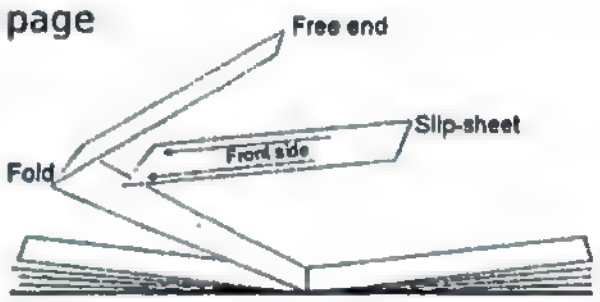
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side

GbsSlipBack-001B

Back

1. Follow instructions on the other side

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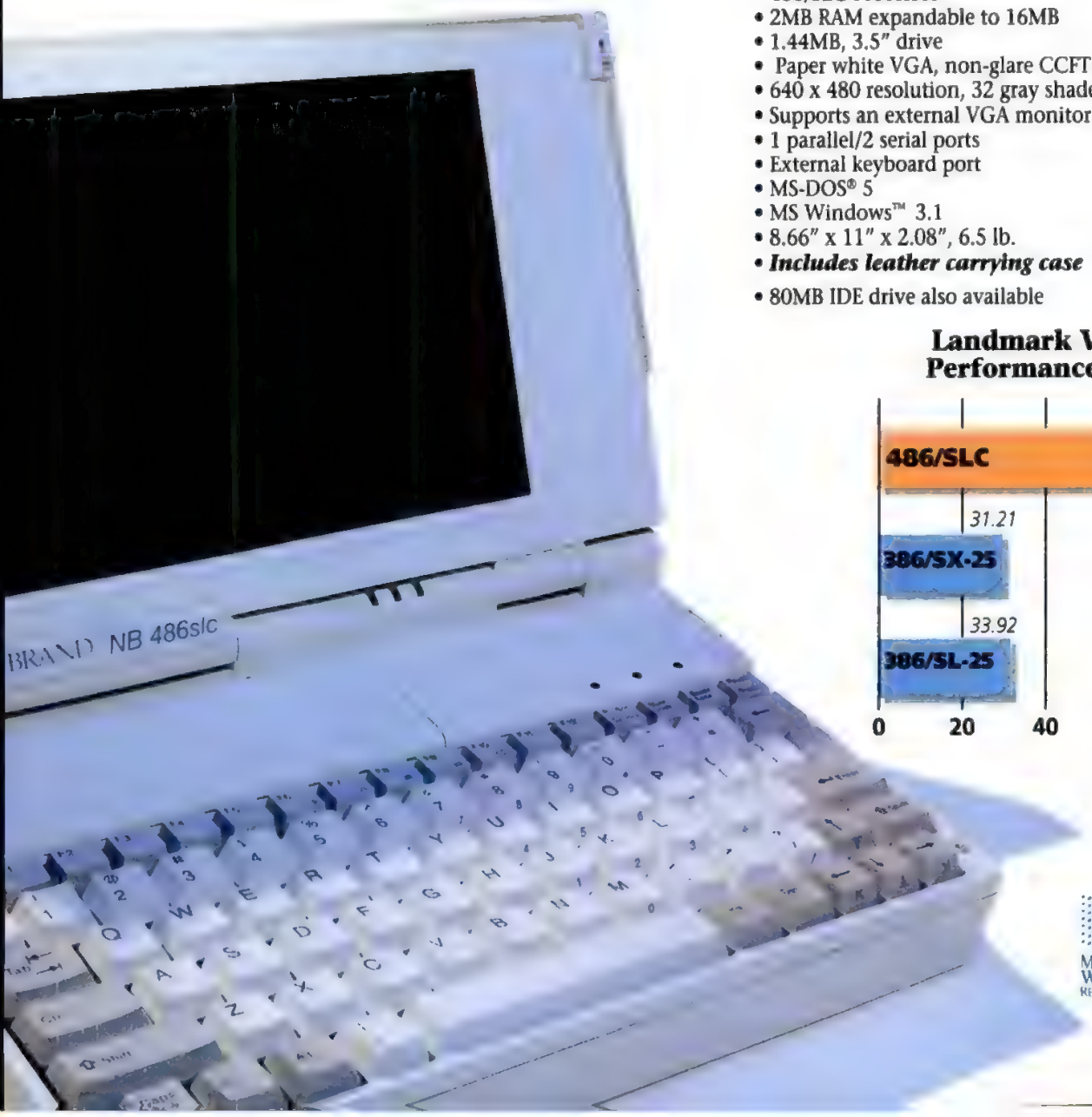

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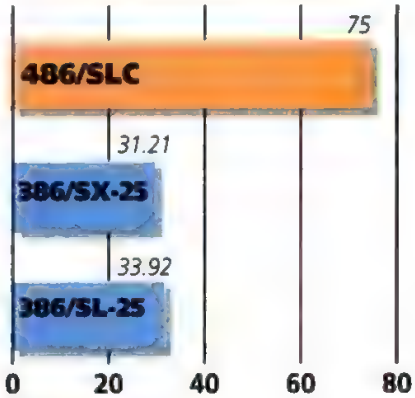

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off an AMD processor, while the NoteStar NP-913 subsists on a 20-MHz Intel 386SX. Apart from this, the NoteStar NP-913 and the Micro Express NB913 share most of the same features, including a 2-by 11.5- by 9.5-inch case that accepts twin snap-in batteries in the back—or a wealth of other accessories. With both batteries in place, the NoteStar NP-913 weighed just over 7 pounds.

Our test unit came with 4MB of RAM but could accept from 2MB to 8MB. It had a 130MB Toshiba MK2124FC hard disk with a 32K buffer, a Citizen 1.44MB floppy disk drive, DOS 5.0, and Microsoft Windows 3.1. A Headland HT21/D video chip set combined with 256K of video RAM powered its 10-inch backlit Sanyo screen. Options include a math co-processor ($175), an internal 9,600-bps fax modem ($144), and a nylon carrying case ($50).

The NoteStar NP-913 yielded solid performance on all our benchmark tests. While its uncached processor turned in respectable but uninspired test scores, its Toshiba hard disk placed seventh among 20-MHz 386-based systems. The twin battery packs showed their worth with a battery rundown time of 3 hours 34 minutes; under test conditions simulating normal use, they lasted 4 hours 34 minutes.

MicroStar offers a one-year warranty on parts and labor and pays for shipping both ways on units sent in for repair. Turnaround is about 48 hours to allow time for testing the repairs. Tech support is free, but the customer pays for the call.—*OR*

SUITABILITY TO TASK

NBCC 386SL/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

NBCC USA Corp.

NBCC 386SL/20

NBCC USA Corp.'s $2,195 NBCC 386SL/20 notebook is a decent computer at a good price. Equipped with Intel's 386SL chip, the NBCC is one of only five 20-MHz units we tested that have a 16K four-way set-associative cache, which helps speed things up. But respectable processor and memory scores are offset by slow graphics performance.

The beige machine measures 2.5 by 12 by 8.5 inches and weighs 7.1 pounds with its battery. Our test unit came with 2MB of 80-nanosecond DRAM (expandable to 8MB) and a 40MB Prairie Tek hard disk. (With Prairie Tek no longer in business, NBCC uses Conner hard disks. A 10-inch Sharp display controlled by a Cirrus Logic GD610/620 chip set with 256K of video RAM displays 32 shades of gray at 640-by-480 resolution and can drive an external monitor at 800-by-600 with 256 colors. It comes bundled with DOS 5.0 and Microsoft Windows 3.1.

As did most of the SL-based systems PC Magazine Labs tested, the unit showed slightly higher processor and memory performance than its 386SX cousins did but fell far behind on the disk, video, and Graphics Winmark tests, scoring near the bottom of the pack. The NBCC's battery lasted 2 hours 2 minutes on our Battery Rundown test; under test conditions simulating normal use, it lasted 2 hours 44 minutes. Power management is accessed through CMOS setup and includes three automatic shutdown procedures: CPU standby, global standby, and auto power off.

The plastic case on our test unit felt as if it didn't quite fit together, and the suspend/resume button required some jiggling to make it work. But the 82-key keyboard has a solid responsive feel. It includes inverted-T cursor controls and separate Home, End, PgUp, and PgDn keys. Ten smaller function keys cross the top of the keyboard, with F1 and F2 doubling as F11 and F12.

Options include a $275 9,600-bps fax modem; the 6MB module that expands the unit's standard 2MB RAM to its 8MB maximum is $595. NBCC offers a one-year warranty on parts and labor. Technical support is handled through dealers and distributors as well as by NBCC's technical staff in Irvine, California.—*Andrew C. Kantor*

FACT FILE

NoteStar NP-913 386SX/20

MicroStar Computers Inc., 35 Cotters Ln., Bldg. C1, E. Brunswick, NJ 08816; 908-651-8686; fax, 908-651-0666

List price (tested configuration): $2,271
Tested Configuration: 4MB RAM, 120MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case
Options: 1MB RAM upgrade, $56; Microsoft Windows 3.1, $54, math coprocessor, $160, extra battery, $69 quick-charge battery adapter, $203, 9,600-bps fax modem, $186

521 ON READER SERVICE CARD

FACT FILE

NBCC 386SL/20

NBCC USA Corp., 216 Technology Dr., Suite E, Irvine, CA 92718; 714-753-8866; fax, 714-753-7524

List price (tested configuration): $2,195
Tested Configuration: 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, DR DOS 6.0, carrying case
Options: 2MB RAM upgrade, $295, 6MB RAM upgrade, $595, upgrade to 60MB hard disk, $200, upgrade to 80MB hard disk, $400; numeric keypad, $125; expansion chassis, $795; car battery adapter, $149; 9,600-bps fax modem, $275.

522 ON READER SERVICE CARD

NCR Corp.

NCR System 3170
NCR Safari NSX/20

NCR Corp.'s NCR Safari NSX/20 (formerly the AT&T Safari NSX/20) shares a number of advanced features with the higher-end NCR System 3170. Geared to mobile users, each comes with preloaded communications software and has a convenient LCD system window that alerts you to incoming e-mail. But their differences are as apparent as their similarities: They vary in size, weight, design, and performance.

The older NCR Safari NSX/20, based on a 20-MHz Intel 386SX, comes standard with 4MB of RAM (upgradable to 8MB) and a 19-millisecond 80MB Conner hard disk for $4,799 ($3,449 for a 40MB unit). The $5,748 System 3170, based on Intel's 25-MHz 386SL, has 4MB RAM (20MB maximum) and a 16-ms 85MB JVC hard disk. Both units accept a cellular-capable 9,600-bps fax modem that can connect with some cellular phones (such as the AT&T 3730) for wireless data transmission. Software includes BitFax and AT&T Access Plus Mail Software for Windows, as well as DOS 5.0 and Microsoft Windows 3.1. An optional Skytel Link Package transmits alphanumeric data to a paging device. Add in good battery life and you have two solid Road Warrior/communications notebooks.

SUITABILITY TO TASK

NCR Safari NSX/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	○	○	○
Desktop replacement	●	●	○	○

NCR System 3170

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	○	○	○

The System 3170, however, offers a PCMCIA (Personal Computer Memory Card International Association) expansion slot in place of the NCR Safari NSX/20's built-in 1.44MB floppy disk drive. It comes standard with an external floppy disk drive that adds almost a pound to the unit's weight of 5.2 pounds (with battery); an internal floppy is optional. The standard case cannot hold the laptop, power supply and charger, and external floppy disk drive at the same time; you'll need the larger one ($99). But even with the external drive, the System 3170 is lighter than the NCR Safari NSX/20, which weighs 7.2 pounds with its battery.

The System 3170 measures 2 by 11 by 8 inches; the NCR Safari NSX/20 measures 2 by 12 by 9.5 inches. The latter notebook has a 10-inch Sharp screen, however, which is slightly larger than the System 3170's 9.3-inch Matsushita screen. Its spacious keyboard has dedicated Home, End, PgUp, and PgDn keys; an inverted-T cursor-key layout; two Alt keys; and larger, more accessible Enter and Backspace keys. The System 3170 gives up the inverted-T cursor-key layout in favor of a built-in FingerPoint mouse that is convenient to use on the road but fairly slow compared with a standard mouse.

The uncached NCR Safari NSX/20 has slightly lower performance for its class than the System 3170 does. It was average on our processor, memory, and disk tests and relatively slower on the video test, making it less suitable for Windows apps than DOS. The System 3170 relies on a 25-nanosecond 64K SRAM cache with four-way set-associative architecture to achieve its strong overall benchmark test performance.

The NCR Safari NSX/20, which holds two batteries, outdoes the System 3170 (and much of the competition) on battery life. On our Battery Rundown test, its nickel cadmium battery lasted 4 hours 6 minutes; it lasted 5 hours 15 minutes with power conservation enabled.

The System 3170, which has one nickel cadmium battery, lasted 1 hour 38 minutes on our Battery Rundown test and 1 hour 50 minutes with power saving enabled. It has a very-low-power suspend mode that turns off all subsystem components except the SL chip, its cache, and system RAM.

NCR offers a one-year warranty, although you must ship the unit to the company or an authorized reseller for repairs. Toll-free technical support is available weekdays.—*Jennifer Zaino*

FACT FILE

NCR System 3170

List price (tested configuration): $5,399

Tested Configuration: 4MB RAM, 80MB JVC hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 14,000-bps data, 9,600-bps fax modem.

Options: 2MB RAM upgrade, $349; 4MB RAM upgrade, $789; with 120MB hard disk, $6,299; math coprocessor, $525; docking station, $899; extra battery, $129; battery charger, $299; carrying case, $99

NCR Safari NSX/20

List price (tested configuration): $4,799

Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, 9,600-bps fax modem

Options: 2MB RAM upgrade, $479; 4MB RAM upgrade, $899; math coprocessor, $525, extra battery, $129; battery charger, $299; 14,000-bps/9,600-bps fax modem, $999; carrying case, $99

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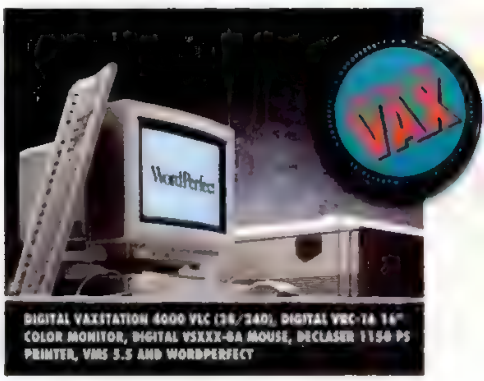

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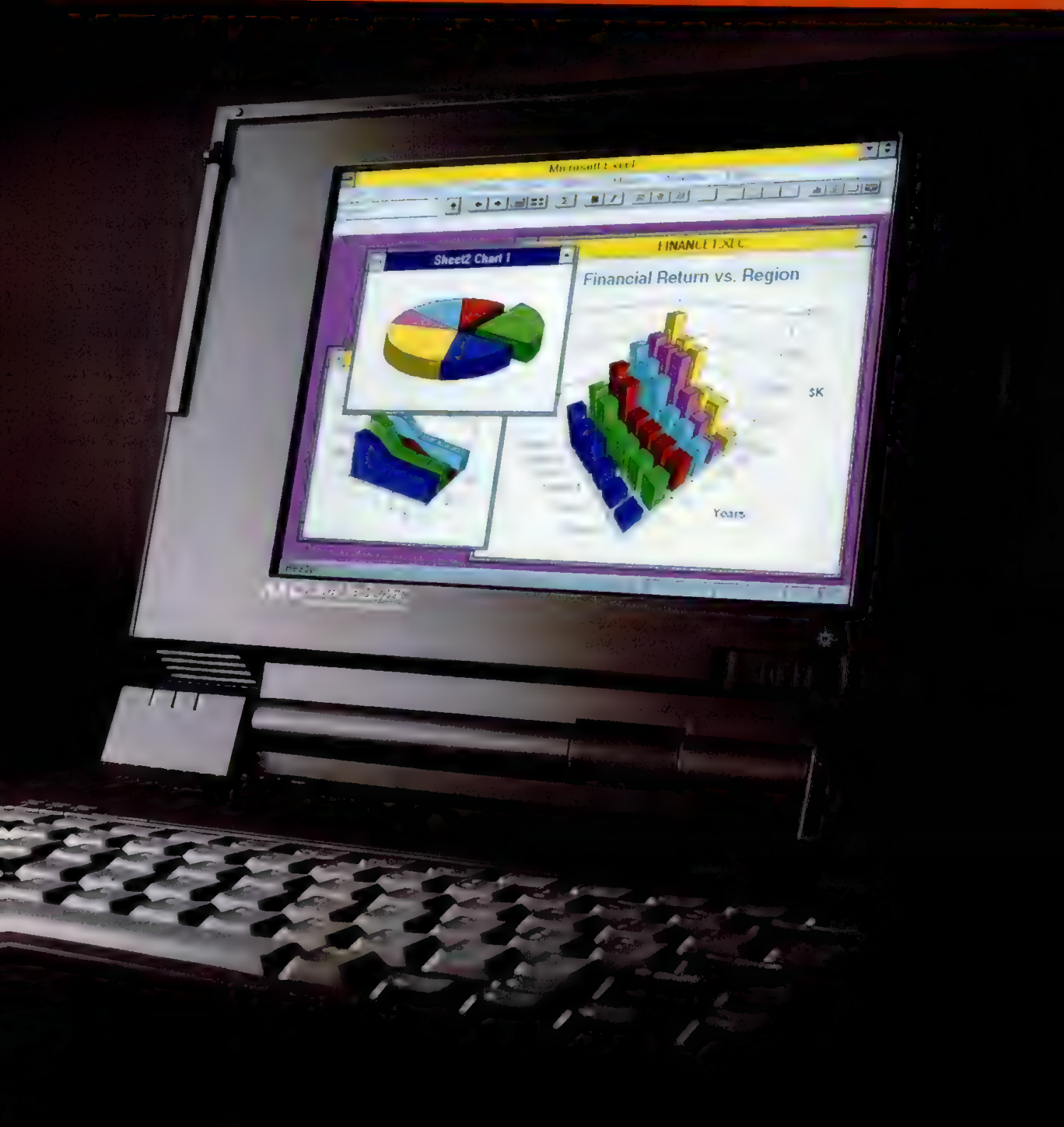

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NEC Technologies Inc.

NEC UltraLite SL/20
NEC UltraLite SL/20P
NEC UltraLite III

Except for a pen-touch screen and its corresponding drop-off in battery life, the pen-based NEC UltraLite SL/20P is the same system as the NEC UltraLite SL/20. But there are features other than the pen-touch screen that make the $3,298 UltraLite SL/20 and the $3,599 UltraLite SL/20P worth considering.

Both systems are based on Intel's power-conserving 386SL-20/Intel 360 chip set, which uses 25-nanosecond SRAM in its 16K four-way set-associative write-through cache. Each comes with 2MB of RAM standard (our test units had the 4MB maximum) and a 16-millisecond 86MB Quantum Go•Drive GD-80 IDE hard disk that has an integrated 32K DisCache with WriteCache firmware—a combination that gave these units well-above-average scores on our disk test. DOS 5.0 and Microsoft Windows 3.0 were preinstalled.

Each has an excellent 9.4-inch screen made by NEC and powered by a Western Digital WD90C20 chip set with 256K of video RAM. The display was crisp and well lit and for the most part, exceptionally clear. Under Microsoft Windows, the UltraLite SL/20P's pen performed adequately; character recognition, however, was slow, tedious, and error-prone. In each case the keyboard was a bit sluggish. The cursor keys are laid out in an inverted T but double as Home, End, PgUp, and PgDn keys.

Each has a sturdy construction and decent battery life, measuring 2.5 by 11.5 by 9.5 inches and weighing 6.4 pounds with their nickel cadmium batteries. Battery life on our Battery Rundown test was 2 hours 5 minutes for the UltraLite SL/20 and 1 hour 38 minutes for the UltraLite SL/20P. Under test conditions simulating normal use, the UltraLite SL/20 lasted 3 hours 45 minutes; its pen-based twin lasted 2 hour 45 minutes.

Like most other SL-based systems in this grouping, these two yielded slightly above-average processor scores and above-average memory scores; disk performance was significantly above average. Video scores were on the high side of average.

The most notable option offered by NEC for its UltraLite SL/20 family is an $899 portable docking station that provides two free slots and a 3.5-inch drive bay for expansion. This is offest by 20-MHz performance and an unfriendly keyboard, leaving the SL/20 family as a fair dektop replacement.

NEC ULTRALITE III

NEC Technologies' NEC UltraLite III is a frustrating combination of some of the best and some of the worst features present today in notebook PCs. At $3,298 with Microsoft Windows and PFS: WindowsWorks, the 4.7-pound portable is one of the smallest fastest systems reviewed here, with a bright, 9.5-inch LCD. A 1.1-pound power supply means a travel weight of less than 6 pounds, unless you need access to a floppy disk drive. The external 1.44MB unit adds another 1.2 pounds. A tight unresponsive keyboard compromises this notebook's usability, as does battery performance that is adequate at best. The UltraLite III is good for traveling light when a floppy disk drive is not needed, but would-be buyers have to answer just one question: Are the compromises too great to make the UltraLite III a viable system?

The UltraLite III hearkens back to the original UltraLite. Its jet-black 1.5- by 11.5- by 9-inch case is smaller and lighter than those of the other machines we reviewed and fits up to 10MB of system RAM. But the now one-year-old design is beginning to show its age. Edges are sharp, the plastic covers for connectors could be stronger, and trickle charging the nonremovable nickel cadmium battery with the unit on takes 8 hours (but just one hour with the unit off).

In terms of performance, the 20-MHz Intel 386SX-based UltraLite III is one of the fastest systems we tested. Only the video combination of NEC's own LCD with the popular WD90C20 video chip set was ordinary, and there is no simultaneous video support through the external VGA port. In particular, the 19-ms 60MB Conner hard disk (the only one NEC offers) with its 32K buffer was the second-fastest among 20-MHz systems. The battery subsystem brings to mind Dr. Jekyll and Mr. Hyde. Good points include user-predetermined screen and hard disk time-outs plus system standby; an instant standby on/off button is located on the system's front edge. You

NEC UltraLite SL/20P, NEC UltraLite III, NEC UltraLite SL/20

SUITABILITY TO TASK

NEC UltraLite SL/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

NEC UltraLite SL/20P

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

NEC UltraLite III

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

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FACT FILE

NEC UltraLite SL/20

List price (tested configuration): $3,268

Tested Configuration: 4MB RAM, 80MB Quantum hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, $269; with 125MB hard disk, $4,637; docking station, $899; 2,400-bps modem, $299, 9,600-bps fax modem, $499; carrying case, $89

NEC UltraLite SL/20P

List price (tested configuration): $4,368

Tested Configuration: same as NEC UltraLite SL/20

Options: same as NEC UltraLite SL/20.

NEC UltraLite III

List price (tested configuration): $2,968

Tested Configuration: 4MB RAM, 60MB Conner hard disk, external 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, PFS WindowsWorks

Options: 2MB RAM upgrade, $269, 4MB RAM upgrade, $629, math coprocessor, $579; numeric keypad, $129, extra battery, $109; battery charger, $299; 9,600-bps MNP 5 fax modem, $499; carrying case, $89.

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-388-8888, 508-264-8000; fax, 800-366-0476

528 ON READER SERVICE CARD

will use standby often, since NEC's 1-hour 45-minute battery life brings up the rear among notebooks that are reviewed here, and cost the UltraLite III its good Road warrior rating. It rates as a good DOS and a fair Windows system, but the compromises are too great to make it your only PC.

The keyboard proved difficult to use since light or glancing keystrokes do not always register. The keyboard's only good feature is that NEC silk-screened useful system functions (like LCD/CRT and Clk High switches) onto it. While the cursor keys are in the desired inverted-T layout, they double as Home, End, PgUp, and PgDn keys and are less than half the size of standard keys.

NEC's healthy list of options for the UltraLite III includes a math coprocessor, memory upgrades, a 9,600-bps MNP 5 fax modem, and a carrying case. The company issues a standard one-year parts and labor warranty on its notebooks. On-site service is available only through dealers; technical support, available weekdays and is toll-free.

—MB and Matthew J. Ross

Olivetti ISC-Bunker Ramo

Olivetti Notebook S20

The $2,919 Olivetti Notebook S20 from Olivetti ISC-Bunker Ramo has an interesting design that could well find a niche in the notebook arena. A touch pad about the size of a business card, located above the keyboard on the right, works much the same way as a mouse or trackball does to control the cursor under Windows. You can operate it with a penlike stylus that ships with the unit or just press it with your finger.

Because of the touch pad's placement, left-handed people may prefer the PS/2 mouse port on the unit's side. The keyboard, however, with dedicated Home, End, PgUp, and PgDn keys and an inverted-T cursor-key layout, is well thought through and comfortable to use.

Based on the 20-MHz Am386SXL processor, the Olivetti measures 2 by 11.5 by 8.3 inches and weighs 6.9 pounds with its nickel cadmium battery. Our test unit came with 4MB of RAM, which is user-expandable to a 6MB maximum with a 2MB module that sells for $240, and room for an 80387SX math coprocessor. It had a 19-millisecond 64MB Conner CP-2064 hard disk with a 32K buffer and an Epson 1.44MB floppy disk drive. The two internal modem options are 2,400-bps data-only and 9,600-bps send-fax. The 8.8-inch Seiko-Epson display seemed a bit small, but it made up for its size in clarity. It was powered by a Cirrus Logic GD610/620 chip set with 256K of video RAM. DOS 5.0 and Microsoft Windows 3.1 came preinstalled.

Olivetti Notebook S20

SUITABILITY TO TASK

Olivetti Notebook S20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Olivetti Notebook S20

Olivetti ISC-Bunker Ramo, 22425 E. Apple Way Ave., Spokane, WA 99019; 800-633-9909, 509-927-5600; fax, 509-927-5700

List price (tested configuration): $2,919.

Tested Configuration: 4MB RAM, 64MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case

Options: 2MB RAM upgrade, $240; 4MB RAM upgrade, $445, DOS 5.0 and Microsoft Windows 3.1, $119; math coprocessor, $149, docking station, $640; extra battery, $85; 2,400-bps modem, $225; 9,600-bps fax modem, $375

527 ON READER SERVICE CARD

The Olivetti's performance was a shade above average on our processor and memory tests and average on our disk test. Video performance on the video and Graphics Winmark tests was in the top half of the field. Its battery life was also good: 2 hours 34 minutes on our Battery Rundown test and 2 hours 45 minutes under test conditions simulating normal use.

This system has only recently been made available in the United States. The company sells through direct mail only and covers the system with a one-year warranty on parts and labor. Units shipped to Olivetti ISC-Bunker Ramo for repair are mirror-shipped back. Toll-free technical support is available 24 hours a day, 7 days a week.—*WPF*

PC Brand Inc.

PC Brand 386SX-25 Notebook

Based on a 25-MHz Intel 386SX processor, the $1,944 PC Brand 386SX-25 Notebook offers solid performance for a low price.

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PC Brand 386SX-25 Notebook

the FCC, the case was originally designed and manufactured by Full Power Investment Corp. of Taiwan. Like these other notebooks, the PC Brand measures 2 by 11 by 8.5 inches and weighs 6.9 pounds with its nickel cadmium battery. Our test unit came with 4MB of 80-nanosecond RAM (expandable to 16MB), a 16-millisecond 122MB Seagate ST9144A hard disk subsystem with a 32K buffer, and a 1.44MB floppy disk drive. A Chips & Technologies 620 chip set with 256K of video RAM powers the 9-inch Sharp screen. The carrying case is included.

SUITABILITY TO TASK

PC Brand 386SX-25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

The PC Brand's processor, memory, and video scores were in the middle of the pack; its hard disk score was slightly better. The unit's battery life was 2 hours 28 minutes on our Battery Rundown test; enabling power-saving features pulled another 17 minutes of life from the system. Processor and disk slowdowns can be configured in setup, and a display time-out feature can be triggered from the keyboard.

Key combinations that control the video display are labeled on the keyboard. The keyboard itself has a clicky feel and is pleasant to use except for some bad key placement: Inverted-T cursor controls double as Home, End, PgUp, and PgDn keys, and the Backslash key is buried to the left of the Spacebar.

PC Brand offers the standard 12-month parts-and-labor warranty; extended service is available for up to 4 years at $200 a year. The vendor mirror-ships repaired units, usually within 48 hours. A toll-free number provides service contact and free nationwide technical support. Among the many options available are a Microsoft Windows/BallPoint Mouse bundle, a car battery adapter, and a 9,600-bps MNP 5 fax modem.—*CK*

FACT FILE

PC Brand 386SX-25 Notebook

PC Brand Inc., 405 Science Dr., Moorpark, CA 93021; 800-722-7263, 805-378-6069; fax, 805-378-7801

List price (tested configuration): $1,944.
Tested Configuration: 4MB RAM, 60MB hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse, carrying case.
Options: 2MB RAM upgrade, $150; 6MB upgrade, $450; 8MB RAM upgrade, $600; 14MB RAM upgrade, $1,050; upgrade to 80MB hard disk, $100; Microsoft Windows 3.1 and mouse, $99; Microsoft Windows and BallPoint trackball, $195; external VGA color monitor, $269; external keyboard, $59; external keyboard adapter, $12; expansion chassis, $369; extra battery, $59; battery charger, $15; additional AC power adapter, $89; car battery adapter, $49; 2,400-bps modem, $119; 9,600-bps MNP 5 fax modem, $249.

ON READER SERVICE CARD

Polywell Computers Inc.

Poly Notebook 320T

Positive Corp.

Positive PC320ND

With twins, the most obvious features are usually the discrepancies. Both the $2,379 Poly Notebook 320T and the $2,299 Positive PC320ND are based on a 20-MHz Intel 386SX processor; both come with 4MB of RAM, DOS 5.0, Microsoft Windows 3.1, a Logitech mouse, and an internal 9,600-bps fax modem. But the Poly features a 130MB Toshiba IDE hard disk; the Positive has a 60MB Conner but adds Works for Windows. With this pair, however, differences don't really matter: Both provide average performance that is easily matched by lower-priced machines in this processor class.

SUITABILITY TO TASK

Poly Notebook 320T

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

SUITABILITY TO TASK

Positive PC320ND

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Apart from color (the Poly is gray, and the Positive is beige), the plastic cases are identical: 2 by 11 by 8.5 inches and 6.8 pounds with the nickel cadmium battery. Each takes up to 16MB of RAM; upgrades cost $48 per megabyte from Polywell Computers and $100 from Positive Corp. Both have a 1.44MB floppy disk drive and a socket for a coprocessor. The Poly has a 9-inch screen made by Toshiba; the Positive's screen comes from Sharp; both screens are powered by a Cirrus Logic GD610/620C chip set with 256K of video RAM.

Both processors were uncached, and while the Positive scored fourth from the top among SX/20s on our memory test, performance on the rest of our tests was average for both units. Battery life for the Poly was 3 hours 7 minutes on our Battery Rundown test and 3 hours 52 minutes

FACT FILE

Positive PC320ND

Positive Corp., 405 Science Dr., Moorpark, CA 93012, 800-252-6345, 805-523-0340; fax, 805-378-7823

List price (tested configuration): $2,299.
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, Microsoft Works for Windows, mouse, 9,600-bps fax modem, carrying case.
Options: 1MB RAM upgrade, $48, 4MB RAM upgrade, $160; external keyboard and VGA monitor, $350; AC power adapter, $80; car battery adapter, $70; leather carrying case, $100.

ON READER SERVICE CARD

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B Stacker 2.0

Stacker 2.0 from Stac Electronics is award-winning software that instantly and safely doubles your disk capacity by compressing and decompressing your data without losing any information. Stacker works on all DOS-based computers, and is ideal for laptops and notebooks as well as desktop systems. **$89**

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CIRCLE 023 ON READER SERVICE CARD

Poly Notebook 320T, Positive PC320ND

with power saving enabled. Surprisingly, the Positive lasted only 2 hours 2 minutes on the Battery Rundown test and 2 hours 32 minutes with power saving enabled. On both machines, power-saving options include hard disk standby, keyboard-triggered display standby, and CPU doze and sleep modes.

The general construction is decent but could be sturdier (on the Positive, one of the flaps covering an expansion port snapped off). The slightly clicky keyboard is easy to use: It features an embedded numeric keypad and keyboard control of the video display. Cursor keys are laid out in an inverted T but double as Home, End, PgUp, and PgDn keys. But the Poly on-screen fonts looked thin or squashed.

Both companies offer a one-year warranty on parts and labor and mirror-ship units sent to them for repair. Both have toll-free lines that operate weekdays and Saturdays for service contacts and nationwide technical support.—*CK*

FACT FILE

Poly Notebook 320T

Polywell Computers Inc., 61-C Airport Blvd., S. San Francisco, CA 94080, 800-999-1278; 415-583-7222; fax, 415-583-1974

List price (tested configuration): $2,379.
Tested Configuration: 4MB RAM, 130MB Toshiba hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse, 9,600-bps fax modem, carrying case
Options: 1MB RAM upgrade, $48; 4MB RAM upgrade, $160; math coprocessor, $159; Microsoft Windows 3.1 and mouse, $80; extra battery, $48; car battery adapter, $100; expansion chassis, $380; 2,400-bps modem, $165; 9,600-bps fax modem, $300

529 ON READER SERVICE CARD

OEM Limited Inc.

Proteus 386/20NB

The $1,795 Proteus 386/20NB was submitted for review by Proteus Computers of Hasbrook Heights, New Jersey. In the course of our testing, however, this company folded, but OEM Limited of Andover, Massachusetts, has picked up the distribution of this nondescript 386SX/20. Company spokesperson Krish Shetty said that OEM Limited was selling the system to Proteus. Now, OEM Limited will sell the system direct to end users. Its $1,795 notebook represents one of the most low-priced values of this laptop roundup. But too much of its appeal may be its price.

Proteus 386/20NB

At 6 pounds even with its 0.7-pound nickel cadmium battery installed, the 2-by 11.5- by 8-inch Proteus is also one of the lightest units in this group. Its 5MB RAM capacity is also among the lightest in this roundup. Our test unit came with 2MB of 70-nanosecond DRAM, a 61MB IDE Areal MD-2060 hard disk (the only size available), a TEAC 1.44MB floppy disk drive, all ports except an expansion port, and an 85-key keyboard. The video display subsystem consisted of a nearly 9-inch Hitachi display powered by a Western Digital WD90C20 chip set with 256K of video RAM.

Performance was average across the board, though both its video and Graphics Winmark scores were slightly better. Due to its small size, battery life was a dismal 1 hour 14 minutes on the Battery Rundown test and 1 hour 24 minutes under test conditions simulating normal use (power saving enabled). This poor battery performance, combined with just one modem option, make the 386/20NB a poor Road Warrior/communications notebook.

A few drawbacks marred construction. The small size and light weight resulted in a flimsy feel. The power button is awkward to use and unmarked, too. The small screen's image controls are difficult to manipulate. The rearward port door is frail, and the latches to open the unit's screen cover are hard on your thumbs. The keyboard, however, was fairly sturdy, with large keys but short travel, and the AC brick was pleasantly small.

OEM Limited had not finalized warranty and support details when this review was completed.—*OR*

FACT FILE

Proteus 386/20NB

OEM Limited Inc., 70 Flagship Dr., N. Andover, MA 01845; 800-878-6427, 508-686-4441; fax, 508-688-3773

List price (tested configuration): $1,795
Tested Configuration: 2MB RAM, 61MB Areal hard disk, 1 44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1 and mouse, carrying case
Options: 4MB RAM upgrade, $285; upgrade to 80MB hard disk, $99, upgrade to 120MB hard disk, $195; upgrade to 230MB hard disk, $645, expansion card, $199, 9,600-bps fax modem, $249

549 ON READER SERVICE CARD

SUITABILITY TO TASK

Proteus 386/20NB

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Sanyo Business Systems Corp.

Sanyo MBC-18NB6H

You'll know the Sanyo MBC-18NB6H is a sturdy, well-built machine when you open the 2- by 12- by 10-inch case. Its slightly large size is matched to a slightly low weight: 6.9 pounds with the nickel cadmium battery. But the question a prospective customer will have to weigh is, how well does an aging technology and a $3,749 price meet future computing needs?

The Sanyo is based on a 20-MHz Intel 386SX. Our test unit came with 4MB of 70-nanosecond DRAM (5MB maximum), a 19-millisecond 60MB Conner CP-2064 hard disk, 1.44MB floppy disk drive, parallel and serial ports, a coprocessor slot, a proprietary slot for an internal 2,400-bps modem, and DOS 5.0. A third-party mouse, not included in the price, can go on the serial port.

The video display subsystem consists of a Sanyo 9-inch edgelit, cold fluorescent LCD that supports just 8 shades of gray at its highest resolution, 640-by-480; most of the competition provides 32 or 64 gray shades. It will support an external display at 640-by-480 with 16 colors, but not simultaneously. The screen is powered by a Western Digital WD37C65CJM chip set with 256K of video RAM.

The Sanyo's performance ranges from the middle of the pack to the low side of average. Battery life was 2 hours 15 minutes on our Battery Rundown test and 3 hours 39 minutes on our ZDigit test.

Unfortunately, the cursor keys double for Home, End, PgUp, and PgDn. A rubber hide-away handle below the keyboard helps you carry the unit, but for serious traveling, you would be better off with the $70 carrying case.

Sanyo offers a one-year warranty on parts and labor. Customers can take the notebook back to the dealer or mail it in, though the toll-free technical support line is helpful in identifying and resolving problems.—*BG*

SUITABILITY TO TASK

Sanyo MBC-18NB6H

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

FACT FILE

Sanyo MBC-18NB6H

Sanyo Business Systems Corp., 51 Joseph St., Moonachie, NJ 07074; 800-524-0047, 201-440-9300; fax, 201-440-1755

List price (tested configuration): $3,749
Tested Configuration: 5MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0
Options: 2MB RAM upgrade, $335, extra battery, $55, battery charger, $120, quick-charge AC power adapter, $199, 2,400-bps modem, $390; carrying case, $70

539 ON READER SERVICE CARD

Sharp Electronics Corp.

Sharp PC-6781 Notebook

The Sharp PC-6781 Notebook is remarkably lightweight, a mere 4.9 pounds with its nickel cadmium battery. Though this low weight may be achieved by skimping on battery life, the Sharp has an impressive array of utilities for conserving power and reducing battery drain.

The slim, dark-gray case, measuring only 1.6 by 11 by 8.5 inches, houses many other features as well. There is a built-in trackball. A switch next to the 10-inch-diagonal Sharp screen lets you toggle between reverse and standard video. A PCMCIA (Personal Computer Memory Card International Association) interface card slot accepts I/O devices such as a modem, or additional memory up to 32MB. You can also add memory via dedicated, proprietary slots easily accessible from the bottom of the computer; these can hold 2MB to 8MB of RAM.

SUITABILITY TO TASK

Sharp PC-6781 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

FACT FILE

Sharp PC-6781 Notebook

Sharp Electronics Corp., P.O. Box 650, Sharp Plaza, Mahwah, NJ 07430; 800-237-4277, 201-529-9593; fax, 201-529-9637

List price (tested configuration): $4,448
Tested Configuration: 8MB RAM, 80MB Western Digital hard disk, 1.44MB floppy disk drive, DOS 5.0
Options: 2MB RAM upgrade, $299, 4MB RAM upgrade, $549; numeric keypad, $119; docking station, $999, extra battery, $119; battery charger, $319; 2,400-bps MNP 5 modem, $499

540 ON READER SERVICE CARD

Our $4,448 test unit, based on an Intel 386SL-20/Intel 360 processor chip set, had 16K of 25-nanosecond SRAM with a four-way set-associative write-through cache). It came with 6MB of RAM, an 80MB hard disk, a 1.44MB floppy disk drive, DOS 5.0, and Microsoft Windows 3.1. Its retail price includes the optional $499 9,600-bps MNP 5 fax modem.

Helped by its processor cache, the Sharp yielded slightly above-average processor and memory scores. Its 16-ms 80MB IBM WDA-280 IDE hard disk was an average performer (it is not removable and therefore cannot be upgraded). Video performance was average. The life of

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CIRCLE 384 ON READER SERVICE CARD

the 0.8 pound battery was a dismal 1 hour 47 minutes on our Battery Rundown test and 2 hours 4 minutes under test conditions simulating normal use. The battery life was certainly a casualty of the system's crash diet.

The Sharp's cursor keys are in the preferred inverted-T configuration, but they double as Home, End, PgUp, and PgDn. The feel of the keyboard is acceptable, but there isn't quite enough resistance in the touch. Screen contrast is good and the display is sharp (no pun intended).

Sharp Electronics Corp. warranties parts and labor for one year, but you ship the unit to the retailer or manufacturer at your own expense. Repair time is generally three days. The service contact and technical support lines are toll-free.—*SC*

Swan Technologies Inc.

Swan 386SX/25 Notebook
Swan 386SX/20 Notebook

Though the $1,880 Swan 386SX/25 Notebook is one of the least expensive 25-MHz 386SXs reviewed and closely resembles the Insight 386-25SXL Notebook, it's a solid product with a highly competitive feature set. If price is your ultimate concern, this Taiwanese import is not a bad value.

Our test unit measured 1.8 by 11 by 8.5 inches and weighed 5.8 pounds with its nickel cadmium battery. It had a low-power, 3.3-volt Am386SXL/25 processor, 3MB of DRAM (1MB standard, 8MB maximum); a removable 19-millisecond 80MB Conner CP-2084 hard disk (42MB and 120MB sizes available); a 1.44MB

SUITABILITY TO TASK

Swan 386SX/25 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Swan 386SX/20 Notebook

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

Epson floppy disk drive; ports (parallel, serial, power, PS/2, and VGA); an 80-key keyboard, DOS 5.0, and Microsoft Windows 3.1. The video display subsystem consists of a 10-inch Samsung LCD screen powered by a Chips & Technologies F82C456 chip set with 256K of video RAM. Modem options are 2,400 data or 9,600-bps fax. Three slots and two slot bays on the side allow additional expansion.

The Swan 386SX/25's performance scores tended to the low side of average; good enough for DOS, okay for Windows. Its battery life was 1 hour 36 minutes on our Battery Rundown test and 2 hours 4 minutes under test conditions simulating normal use. An internal standby battery lets you swap the external battery without turning off the power.

The case construction, however, has some drawbacks. Like the Insight, the Swan 386SX/25's front clasp feels like it will break. Home, End, PgUp, and PgDn keys are combined with the cursor keys, and as with the Insight, you must open the plastic rear panel to plug in the AC power cord. On a positive note, the power brick is small, the battery is easy to install and remove, and there are nicely varied power-conservation features, including standby, LCD and hard disk time-out.

SWAN 386SX/20 NOTEBOOK

The Swan 386SX/20 Notebook, based on an AMD CPU, measures 2.1 by 11 by 8.5 inches and weighs 7 pounds with its nickel cadmium battery. Our $1,995 test machine had 4MB of system RAM (1MB standard, 8MB maximum), a non-removable 19-millisecond 60MB Conner CP-2024 hard disk (42MB, 61MB, and 120MB units available), a 1.44MB Epson floppy disk drive, an 80-key keyboard, all the usual ports behind a solid rear door, DOS 5.0, and Microsoft Windows 3.1. Originally the unit had a slightly smaller screen, an 8-inch-diagonal Samsung, though the newer versions of this model come with a 10-inch, 64-shade LCD screen.

The Swan 386SX/20 Notebook's performance was average, with the exception being the battery life: 2 hours 39 minutes on our Battery Rundown test and 3 hours 52 minutes on our ZDigit test.

The 80-key keyboard is a bit larger than the 25-MHz model's and has good-size keys with decent travel, but the cur-

FACT FILE

Swan 386SX/25 Notebook

List price (tested configuration): $1,880

Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, 9,600-bps fax modem, DOS 5.0, Microsoft Windows 3.1, carrying case

Options: 2MB RAM upgrade, $190, 4MB RAM upgrade, $370; 6MB RAM upgrade, $550, Microsoft Windows 3.1, $79; math coprocessor, $105; numeric keypad, $49, quick charger, $99, 2,400-bps modem, $119, 9,600-bps fax modem, $229.

Swan 386SX/20 Notebook

List price (tested configuration): $1,995

Tested Configuration: 8MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, $190, 4MB RAM upgrade, $370; 6MB RAM upgrade, $550; Microsoft Windows 3.1, $79, math coprocessor, $105; numeric keypad, $49, extra battery, $79, quick charger, $89, 2,400-bps modem, $119; carrying case, $59.

Swan Technologies Inc., 3075 Research Dr., State College, PA 16804-9959; 800-468-9044, 814-238-1820; fax, 814-237-4450

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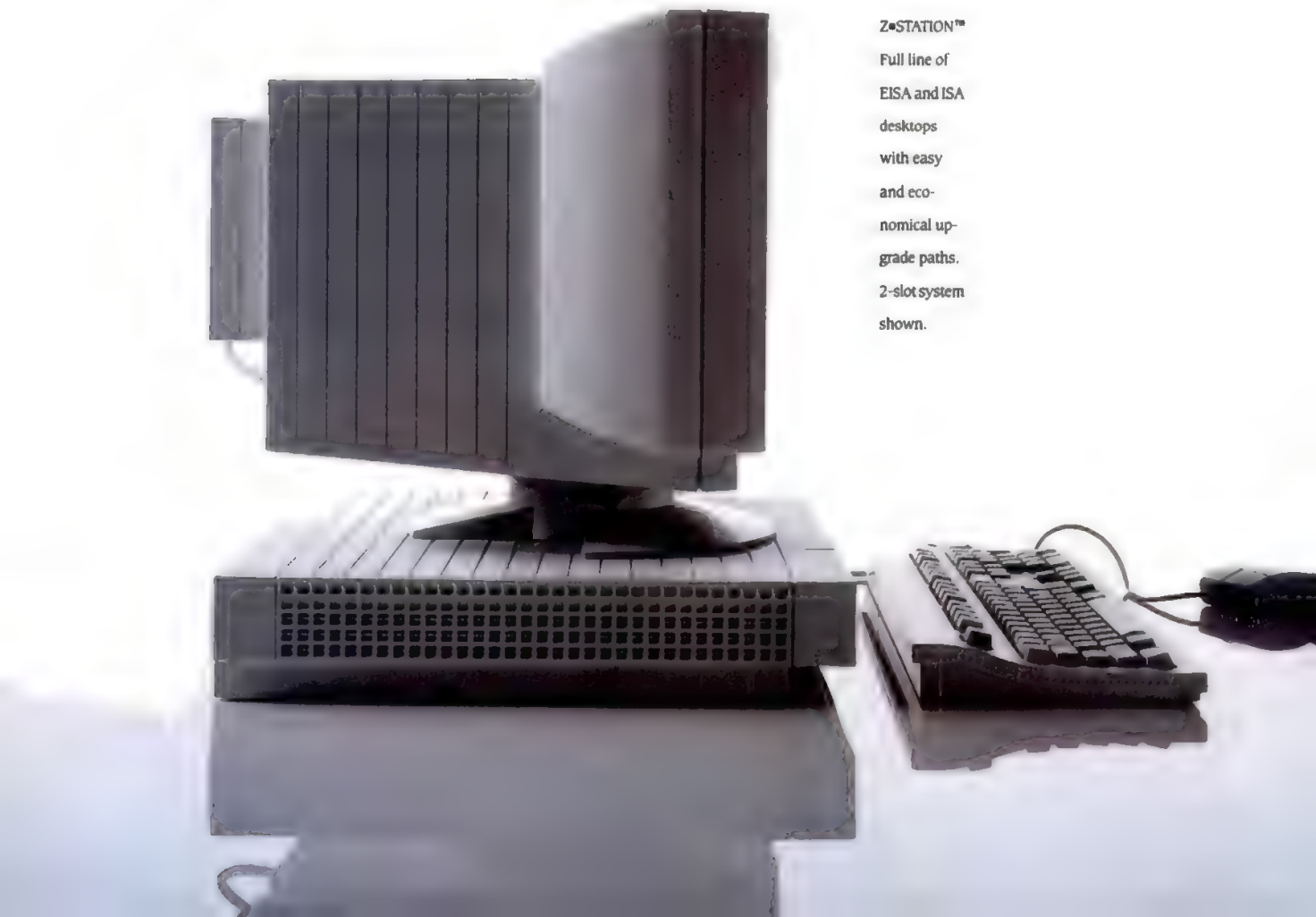

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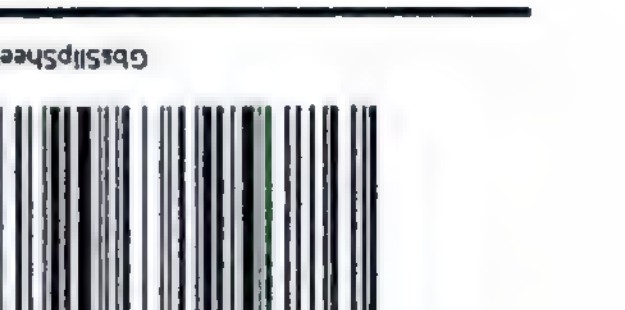
Folded edge of the page

GbsSlipSheet-001

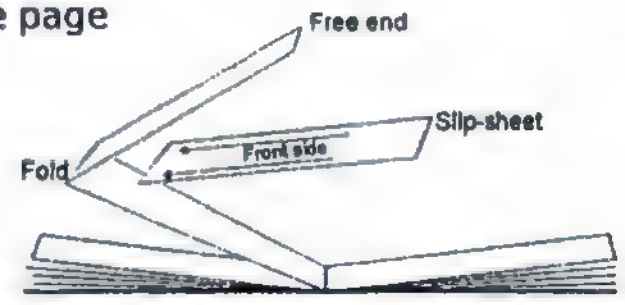
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side

GbsSlipBack-001B

Back

1. Follow instructions on the other side

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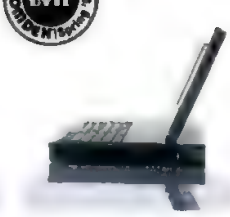

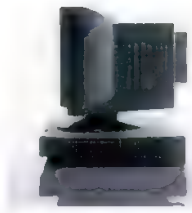

	Z•SPORT	Z•NOTE	Z•STATION ISA	Z•STATION EISA	Z•SERVER EISA
Processor/MHz	i386•SX/25 i486•SX/20 i486SX/25	i386SL/20 i386SL/25	i386SX/25 i486SX/20 i486SX/25 i486DX/33	i486SX/20 i486DX/33 i486DX2/50	i486SX/25 i486DX/33 i486DX/50
Storage	60, 85, 120MB*	60, 85, 120MB*	80, 120, 200, 400MB	120, 200, 400MB	300, 400, 500MB* (up to eight)
Memory (Standard/Max)	2/8MB* 4/12MB*	2-4*/12MB	4/64MB	4-8*/128MB	4-8*/192MB
Video	VGA display up to 64 gray scales	VGA display up to 64 gray scales or active matrix color	Integrated SVGA @ 1024x768 resolution with 16 colors. Upgradeable to 256 colors.		Integrated SVGA @ 1024x768 resolution with 16 colors. Upgradeable to 256 colors.
Pre-installed Operating Systems	MS-DOS 5.0 with APM	MS-DOS 5.0 with APM, Microsoft Windows 3.1	MS-DOS 5.0 Microsoft Windows 3.1		MS-DOS 5.0*
Integrated Connectivity	N/A	Novell NetWare, Microsoft LAN Manager, Banyan VINES client shells pre-installed	Novell NetWare, Microsoft LAN Manager, Banyan VINES client shells pre-installed		Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO™ UNIX®**
Upgrade Options	Memory, HDD, Coprocessor	Video display, Memory, BIOS, HDD, FDD, Coprocessor	CPU, Memory, BIOS, FDD, HDD, Coprocessor, OverDrive™ processor, Windows accelerator module (WAM), SCSI module, SCSI tape backup, SCSI hard drive		CPU, Cache, BIOS, HDD, FDD, Coprocessor, OverDrive processor, SCSI streamer and DAT tape drives, CD-ROM drive, LAN boards, Serial port boards
Mouse	Optional	Logitech™ TrackMan® Portable	Microsoft Two-button		Optional
Battery Life	2 or 2.5 hours under APM*	4-10 hours under Premier System Management™ (⅓ less in color)	N/A		N/A
Weight	6 or 6.2 lbs.*	5.9 or 6.5 lbs.*	N/A		N/A
Optional Peripherals	AT Docking Unit 3 slots AT compatible 2 half-height drive bays	READYDESK port replicator	N/A		N/A

intel inside

MICROSOFT® WINDOWS™ READY-TO-RUN

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*Dependent upon specific model
**Pending certifications

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sor keys are in an L-shape layout. The Epson floppy disk drive has a weak feel, but the rest of the case is sturdy, including the interface port door.

Swan warranties its notebooks for one year on parts and labor; technical support is toll-free. The unit's modular design facilitates troubleshooting, parts shipment, and repairs.—*OR*

Tandy Corp.

Tandy 4860 HD
Tandy 3830 SL

At $3,499, the Tandy 4860 HD is the most expensive 33-MHz 486DX notebooks in this roundup (the units from Aquiline and Compudyne Products are cheaper), but it still costs less than many of the 20- and 25-MHz systems we saw. In fact, its price and service are its greatest strengths.

The Tandy 4860 HD measures 1.7 by 11 by 8.7 inches and weighs 5.8 pounds with its nickel cadmium battery. It arrived in a slim, minimally packaged box that included the unit, an AC brick and power cord, a battery, and, in PC Magazine Labs' case, DOS documentation only (Tandy was still printing the system documents). Internally, you will find 4MB of RAM standard (20MB maximum), a coprocessor slot, a 19-millisecond 63MB Western Digital WDAH260-00 hard disk with a 32K buffer, a 1.44MB Epson floppy disk drive, and the usual complement of ports. A 9,600-bps fax modem is optional. DOS 5.0, Windows 3.1, and Works for Windows 2.0 are preinstalled on the hard disk and included in the price. The 9.5-inch monochrome display is made by Sharp and powered by a Cirrus Logic chip set with 256K of video RAM.

In terms of performance, the Tandy 4860 HD ran a close race with its closest competitor, the Compudyne 486DX/33/33. Both had strong scores, but the Tandy 4860 HD's Western Digital hard disk was slower than the Compudyne 486DX/33's 130MB Toshiba unit. Also, 63MB seems scant space when you consider the workload a 486/33 usually faces. The battery life was 2 hours 15 minutes on our Battery Rundown test and 2 minutes 23 seconds with power-saving features enabled. However, the Tandy 4860 HD's power-management system does not allow for the specific setup of screen timeouts. Instead, it has an "automatic" timeout set for about 5 minutes. The Tandy 4860 HD's time on our ZDigit Rundown test, then, was not as good as those of similar systems because under our test conditions, the screen is kept on at least 3 minutes longer for each test cycle. Over ten test cycles, for example, the screen is on for an additional 30 minutes. Power-management utilities can be turned on or off but not set to different times by the user.

SUITABILITY TO TASK

Tandy 4860 HD

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Tandy 3830 SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

The case's construction was reasonable, but a stronger case would reassure potential buyers. It is very close to the case featured in Compudyne Products's notebooks, but Tandy doesn't offer an internal trackball. Its 84-key layout was usable but lacked full key travel. Instead of making space-saver keys half-height, Tandy made them half-width—even more prone to typos, at least for users who have thick fingers. This includes not only the function keys but also the cursor keys.

FACT FILE

Tandy 4860 HD

List price (tested configuration): $3,499.

Tested Configuration: 4MB RAM, 60MB Western Digital hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $399.95; extra battery, $109.95; trackball, $99.95; 9,600-bps fax modem, $199.95; fabric carrying case, $39.95; leather carrying case, $99.95.

Tandy 3830 SL

List price (tested configuration): $2,999.

Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, $399.95; 6MB RAM upgrade, $1,099; docking station, $699; extra battery, $199.95; 9,600-bps fax modem, $199.95; fabric carrying case, $39.95; leather carrying case, $99.95.

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102, 817-390-3011

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TANDY 3830 SL

Based on a 25-MHz Intel 386SL processor, the $2,999 Tandy 3830 SL measures 1.7 by 11.7 by 8.7 inches and weighs 5.9 pounds with its nickel hydride battery. Even with its $3,000 price, it's a decent value, but with just a $500 difference between this 25-MHz 386SL and a 486/33, you may opt for the Tandy 4860 HD.

The processor's 16K of 25-nanosecond SRAM cache helped it win very competitive scores on our processor and memory tests. The unit also ranked third on both our video and Graphics Winmark tests, though the Toshiba MK2124 IDE hard disk trailed the pack. Its battery lasted 2 hours 39 minutes on our Battery Run-

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down test and 2 hours 30 minutes on our ZDigit test. The Tandy 3830 SL suffered the same problem as its 486 cousin in setting the screen backlight time-out. As with the Tandy 4860 HD, its automatic time-out intervals gave the unit poorer scores than it otherwise would have had.

The rest of the unit's gear is fairly typical and consists of 2MB to 8MB of DRAM, an 80MB Conner IDE hard disk (no other size is presently available), a 9.8-inch monochrome Sharp LCD screen, a 1.44MB Mitsumi floppy disk drive, the requisite ports, DOS 5.0, and Microsoft Windows 3.1.

There's even an 84-key keyboard with the built-in trackball sported by the Compudyne portable but missing from Tandy's 486/33 notebook. The trackball rests above the keyboard, awkwardly placed close to the display hinge. Users will almost certainly have to rest their hands on the keyboard after more than a few minutes. Though the keyboard gives a good try at a full-size feel, its key travel is noticeably short. Though the case is sturdy, the power key and the floppy disk drive feel flimsy.

Tandy offers a standard one-year parts-and-labor warranty on both machines. A point in Tandy's favor is that you can take the unit in for service at any Radio Shack Authorized Service Center or authorized dealer. Technical support is via regular toll calls.—*OR*

SUITABILITY TO TASK

Tartan NP-925

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	○	○	○

FACT FILE

Tartan NP-925

Tartan Computers, 44 W. Ferris St., E. Brunswick, NJ 08816; 908-390-1900; fax, 908-390-9380

List price (tested configuration): $2,199

Tested Configuration: 4MB RAM, 124MB Toshiba hard disk, 1 44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case

Options: 2MB RAM upgrade, $52, math coprocessor, $159, external keyboard, $42, extra battery, $56, battery charger, $159; SCSI adapter, $79; 2,400-bps modem, $110, 2,400-bps MNP 5 modem, $150, 9,600-bps fax modem, $150

545 ON READER SERVICE CARD

Tartan Computers

Tartan NP-925

The $2,199 Tartan NP-925 is close kin to the Micro Express NB925 and the NoteStar NP-925 386SX/25. They differ in their respective engines but share the same modular design—right down to the size, weight, keyboard, and accessories.

Like these other clones, the Tartan measures 1.8 by 12 by 9.5 inches and weighs 7.8 pounds with its twin nickel cadmium batteries. Based on a power-conserving 25-MHz Am386SXL processor, our test unit arrived with 4MB of DRAM (2MB standard to 8MB maximum), a 17-millisecond 130MB Toshiba MK2124FC hard disk (also available in 40MB or 80MB), a Citizen 1.44MB floppy disk drive, parallel and serial ports, an 84-key keyboard, and DOS 5.0 (Microsoft Windows is available at an extra cost). The video display subsystem consists of a 10-inch Sanyo LCD driven by a Chips & Technologies F82C456 chip set with 256K of video RAM. A 9,600-bps fax modem costs $150; a coprocessor, $159.

In place of a docking station or expansion port, Tartan Computers uses the same twin-battery-pack design found in the Micro Express and NoteStar notebooks. All the devices that you would hook to a docking station are available as snap-in modules that attach to the main unit in place of one of the batteries. You can run the unit on one battery or on

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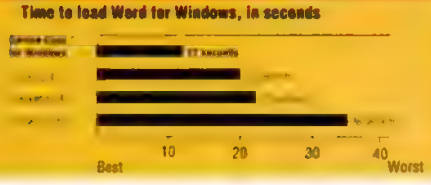

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▶ SUMMARY OF FEATURES

Monochrome Portables

List price (tested configuration) *PC Magazine* usually compares the prices of similarly equipped machines, but the configurations for these monochrome portables defy standardization. We therefore provide the price of each system as delivered to *PC Magazine* and tested by PC Magazine Labs

The tested configurations of all the systems in this section include DOS 5.0. Some vendors also bundle Microsoft Windows 3.1 with their systems.

Distribution channel Some machines are sold directly through mail order, others through dealers. Dealers have previously offered discounts of 25 percent or more off the list price; however, an industry-wide price restructuring has cut these discounts in many cases. *PC Magazine* views a 15 percent discount as typical

In addition to direct sales, some PC vendors are now offering their systems through company-owned stores and superstores

Weight/travel weight Each notebook's weight includes the weight of the battery. The travel weight adds that of the AC adapter brick and power cord. For AC-powered systems without batteries, we report only one weight, which includes the power cord.

Keys: total, function, cursor The table describes each portable PC's built-in keyboard: the total number of keys, the number of function keys (10 or 12), and the number of cursor keys (0, 4, or 8) If you have only 4 cursor keys on your unit and you need to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys—an inconvenient extra step.

Motherboard manufacturer Some machines are based on motherboards made by major manufacturers, although their other components may vary.

The **chip set manufacturer** makes the logic connecting the CPU with the other functions managed by the system board

The **BIOS version (or date)** can affect PC Magazine Labs' benchmark test results A machine with another BIOS may perform differently.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced performance speed Shadowing uses RAM located between 640K and 1MB

Proprietary expansion port Some machines have an expansion port that lets you connect the system bus to an external device, such as an expansion station or external floppy disk drive.

The **PCMCIA slot** accepts removable I/O devices roughly the size of a credit card. Currently, add-in components that fit this form factor include expansion memory, nonvolatile SRAM for storage, and modems. The PCMCIA (Personal Computer Memory Card International Association) standard continues to evolve, there are currently two versions.

An **expansion unit,** also called a docking station or expansion station, provides additional space for standard expansion cards and hard disks, tape drives, and floppy disk drives.

Internal modem options describes the functions and compression schemes of the vendor's modem options. Unless otherwise noted, data modems run at 2,400 bits per second and fax modems at 9,600 bps. A 9,600-bps fax modem has send-and-receive fax capabilities at 9,600 bps and also has 2,400-bps data-modem capability. We also identify send-only fax modems. Such fast modems benefit from built-in data compression and error control. *MNP 5 compression* is the most widespread form of data compression in use and includes MNP 2 through MNP 4 error control. *V.42 error control* is an emerging standard, as is *V.42bis compression*, which includes V.42 error control and MNP 5 compression. Whenever possible, you should consider MNP 5 compression as a minimum requirement.

Screen manufacturer Most vendors purchase liquid crystal displays from outside sources. Furthermore, these panels are physically limited in the number of **shades of gray** they can display.

The **video chip set manufacturer** makes the logic that drives the LCD screen and any external monitor hookup. The chip set and video memory determine the **maximum external resolution** and number of simultaneous colors the external monitor can display.

Maximum external colors Lowering an external monitor's resolution usually increases the number of colors it can display

The **AC adapter size** can vary significantly among machines with similar power needs.

The **rated battery life** is the vendor's rating for the internal battery or batteries. PC Magazine Labs independently tests the battery life and reports the results of our Battery Rundown and ZDigit Rundown tests. The ZDigit test lets each notebook use its power-conservation features, while the Battery Rundown test gives a worst-case result. We also indicate the battery **charge time** with the unit on and off, as reported by the vendors.

The **battery weight, amp/hour rating** line shows the battery's weight in pounds, as well as how long that battery is rated to deliver a current of 1ampere per hour. You'll notice a wide discrepancy between the sizes and power ratings of batteries in this issue.

The battery-powered systems in this review all include power-conservation features, such as automatic **display** dimming or blanking, automatic **hard disk power-down** (a common feature), slowing or halting the **CPU,** and removing power from I/O ports (modem and serial ports) when the machine is not in use. More advanced power-management features include **standby** mode, whereby a system preserves its current state in memory, via a secondary battery in most cases; and **hibernation,** in which the system's state is written to the hard disk or preserved by a secondary battery. The latter ensures that the system never loses its information when its primary battery power fails.

All systems included in this section came with at least a one-year parts-and-labor warranty. See the individual reviews for details on each vendor's support policies. Furthermore, every system was certified by the Federal Communications Commission with a Class B rating. This shows that an electronic device has sufficiently low radio-frequency emissions to be used in the home. Portable PCs must have a Class B certification. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072.

CONTINUES

▶ SUMMARY OF FEATURES

Monochrome Portables

Companies listed in alphabetical order ■ = YES □ = NO	Altec 386SX/25 Notebook	Aquiline NT33	AST Premium Exec 386SX/20	AST Premium Exec 386SX/25	Austin 386SX-25 Notebook	BCC Avanti 025	BCC SL007
List price (tested configuration)	$2,624	$2,595	$3,295	$3,295	$2,293	$3,699	$5,995
Processor type and speed	AMD Am386SXL/25	Intel 386DX/33	Intel 386SX/20	AMD Am386SXL/25	AMD Am386SXL/25	AMD Am386SXL/25	AMD Am386SXL/20
Hard disk capacity	80MB	170MB	80MB	80MB	60MB*	130MB	80MB
Microsoft Windows 3.1	■	□	■	■	□	■	■
Distribution channel	Direct	Direct, VARs	Dealers	Dealers	Company-owned stores, dealers	Dealers	Dealers
Dimensions (HWD, in inches)	2 x 11 x 8.5	2.3 x 11 x 10	2.5 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	3 x 11.5 x 9	2.5 x 11 x 8.5
Weight/travel weight (pounds)	6.3, 7.9	8.5, 10.2	6.7, 8.4	6.6, 7.9	6.8, 8.7	6.5, 7.8	6.6, 7.6
Display area (H x W, in inches)	6 x 7.5	5.2 x 7	5.2 x 7	5.2 x 7	6 x 7.5	6 x 7.5	5.7 x 7.7
Keys: total, function, cursor	81, 10, 4	83, 10, 8	82, 10, 8	82, 10, 8	80, 12, 4	80, 10, 4	80, 12, 4
Motherboard manufacturer	Sampo	Aquiline	AST	AST	Sampo	BCC	BCC
Chip set manufacturer	VLSI	C&T	WD	WD	VLSI, Intel	WD	Intel
BIOS version (or date)	Phoenix 1.1	Award 3.20	AST 1.06	AST 1.15	Phoenix 1.1	Award (Feb. 1992)	Award (Feb. 1992)
Setup in ROM/Password in ROM	■■	□□	■■	■■	■■	■■	■■
System shadowing/Video shadowing	■■	■■	■■	■■	■■	■■	■■
Memory and Disk Drives							
Installable RAM	3MB–8MB	2MB–16MB	4MB–8MB	4MB–8MB	1MB–8MB	2MB–8MB	4MB–8MB
User-installable	■	■	■	■	■	■	■
External processor RAM cache	None	32K	None	None	None	None	64K
Available hard disk sizes	60MB, 80MB	120MB, 170MB, 213MB	40MB, 60MB, 80MB, 120MB	60MB, 80MB, 120MB	60MB	60MB, 80MB, 130MB	80MB, 130MB
I/O and Expansion							
Parallel, serial, mouse ports	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 1
Proprietary expansion port	■	□	□	□	□	□	□
PCMCIA slot	□	□	□	□	□	□	□
Expansion unit	□	$450	□	□	□	□	□
Internal modem options	4,800-bps send-fax ($125)	9,600-bps MNP 5 fax ($195)	2,400-bps ($249), 9,600-bps send-fax ($349), 9,600-bps data/fax ($499)	2,400-bps ($249), 9,600-bps send-fax ($349), 9,600-bps data/fax ($499)	4,800-bps fax ($199)	9,600-bps fax (included)	9,600-bps fax (included)
Video							
Screen manufacturer	Sharp	Sharp	Epson	Epson	Sharp	Sharp	Sharp
Maximum shades of gray	32	32	32	32	32	32	32
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	WD	WD
Simultaneous external display	□	□	□	□	□	□	□
Maximum external resolution	800 x 600 x 16	800 x 600 x 16	640 x 480 x 16	640 x 480 x 16	800 x 600 x 16	640 x 480 x 16	640 x 480 x 16
Maximum external colors	256	256	16	16	16	16	16
AC Adapter and Battery							
AC adapter size (inches)	2 x 3.5 x 6	2.3 x 3 x 6.5	2 x 3 x 6.5	1.5 x 2.3 x 6.5	2.3 x 3.5 x 6	2 x 2.5 x 6	1.5 x 2.5 x 5.8
Rated battery life (hours)	3	3	3	2	2	2–8	2–8
ZDigit, battery rundowns (hr:min)	4:47, 2:53	1:51, 1:37	2:18, 1:47	6:12, 3.55	4:48, 2:56	2:45, 1:59	N/A, 1:49
Charge time while on, off (hours)	5, 3	3, 3	N/A, 3	N/A, 3	2.5, 2	10, 1	10, 4
Battery weight, amp/hour rating	1.1 lbs, 2.8Ah	2.2 lbs, 2.8Ah	1.2 lbs, 5Ah	1.2 lbs, 5Ah	1.1 lbs, 2.8Ah	1.8 lbs, 1.7Ah	1.2 lbs, 1.7Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	■□	■■	■■	■□	■■	■■
Standby/Hibernation	□□	□□	■□	■□	■■	■■	■■

N/A—Not applicable. The product does not have this feature. *The Bondwell 386SL/F Notebook's weight does not include the 0.6-pound external floppy disk drive.
ASIC—ASIC Design Inc., C&T—Chips & Technologies Inc., LES—Less Extensive Systems, MCC—Micro Computer Corp.,
SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

Blackship NB 320S	Blue Star 386DX/25 Notebook	Blue Star 386SX/25 Notebook	Bondwell 386SL/F Notebook	Compaq LTE 386s/20	Compaq LTE Lite/20
$2,245	$2,899	$2,199	$2,699	$4,099	$3,999
Intel 386SX/20	Intel 386DX/25	Intel 386SX/25	Intel 386SL/25	Intel 386SX/20	Intel 386SL/20
85MB	120MB	80MB	80MB	60MB	80MB
☐	■	■	☐	☐	☐
Direct	Dealers, direct	Dealers, direct	Dealers, direct	Dealers, superstores	Dealers, superstores
2.1 x 11 x 8.5	2.5 x 11 x 8.3	1.7 x 12 x 9.5	1.5 x 11.5 x 8.5	2.3 x 11 x 8.5	1.7 x 11 x 8.5
6.7, 8.6	7.5, 9.1	7.9, 9.4	5.5, 6.8 *	7.6, 9.3	6.1, 7.3
5.5 x 7	7 x 8.5	5.5 x 7.5	5 x 7	5.5 x 7.5	5.5 x 7.5
80, 10, 4	84, 12, 4	83, 10, 8	81, 10, 4	80, 10, 4	80, 12, 4
Intra	Amrel	MCC	Bondwell	Compaq	Compaq
VLSI	SIS	Headland	Intel	Compaq	Compaq
AMI 1.3	AMI (June 1990)	AMI (June 1990)	Quadtel 3.06	Compaq (Feb. 1992)	Compaq (Jan. 1992)
■■	■☐	☐☐	■■	■☐	■■
■■	■■	■■	■■	☐■	■■
1MB–5MB	2MB–8MB	4MB–8MB	2MB–8MB	2MB–10MB	2MB–10MB
■	■	☐	■	☐	■
None	128K	None	16K	4K	None
60MB, 85MB	60MB, 80MB, 120MB	60MB, 80MB, 130MB	60MB, 80MB	30MB, 60MB	40MB, 60MB, 80MB
1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	2, 1, 1	1, 1, 1
■	■	☐	■	■	☐
☐	☐	☐	☐	☐	☐
☐	$359	☐	☐	$929	$929
9,600-bps fax ($220)	9,600-bps fax ($225)	None	2,400-bps V.42bis (included)	2,400-bps ($319), 9,600-bps data/fax ($599)	2,400-bps ($319), 9,600-bps data/fax ($599)
Sanyo	Sanyo	Sanyo	Hitachi	Compaq	Compaq
16	64	64	64	16	16
Cirrus	Cirrus	C&T	Cirrus	Compaq	Compaq
☐	☐	☐	■	☐	☐
800 x 600 x 16	800 x 600 x 16	800 x 600 x 16	640 x 480 x 16	640 x 480 x 256	640 x 480 x 16
256	256	16	16	256	16
2 x 3.1 x 6.5	2 x 3 x 6.5	1.5 x 3 x 7	1.5 x 5 x 5.5	2.5 x 3 x 5.1	1.4 x 3.3 x 5.3
1.5	3	4–6	3.5	3	4.5
2:59, 1:45	2:59, 2:12	4:21, 3:03	2:03, 1:37	4:07, 2:59	3:26, 2:16
12, 6	2.5, 2	2.5, 2	12, 1	3, 1.5	1.5, 1
1.1 lbs, 2.5Ah	1.3 lbs, 2Ah	1 lb, 4Ah	0.8 lbs, 2.2Ah	1.8 lbs, 1.7Ah	1.3 lbs, 2.2Ah
■■	■■	■■	■■	■■	■■
■☐	☐☐	☐☐	■■	■■	■■
■■	☐☐	☐☐	■■	■■	■■

CONTINUES

AC power. Accessories include a SCSI interface for a CD-ROM drive and an Ethernet card.

Performance ranged from slightly higher than average on the disk test to slightly lower in terms of video, though all its scores were strongly grounded within the average range. The battery life was 3 hours 48 minutes on our Battery Rundown test and 4 hours 20 minutes under test conditions simulating normal use.

Tartan offers the standard one-year warranty on parts and labor. It encloses a prepaid UPS Red Label in the carrying case so that you can mail the unit in; repairs generally take two working days. Technical support is toll-free.—*OR*

Texas Instruments Inc.

TI TravelMate 3000 WinSX

As if you couldn't tell by the name, the TI TravelMate 3000 WinSX is designed specifically to take advantage of Microsoft Windows and its related applications. The $3,199 system comes with Windows loaded and ready to run right out of the box. Complete with hand-held trackball and Windows-based utilities, this is a highly suitable Road Warrior/communications system that many on-the-go Windows users may want to consider.

Based on an uncached 20-MHz Intel 386SX processor, the charcoal-gray unit

SUITABILITY TO TASK

TI TravelMate 3000 WinSX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

▶ SUMMARY OF FEATURES

Companies listed in alphabetical order ■ = YES □ = NO	Compaq LTE Lite/25	CompuAdd Express 325NXL	Compudyne 386SXL/25	Compudyne 486DX/33	Cumulus Express 386SX/20 Notebook	Dauphin 1050 Lapbook	DECpc 320P Notebook
List price (tested configuration)	$4,199	$2,095	$1,806	$3,206	$2,299	$4,590	$2,245
Processor type and speed	Intel 386SL/25	AMD Am386SXL/25	AMD Am386SXL/25	Intel 486DX/33	Intel 386SX/20	Intel 386SX/20	Intel 386SX/20
Hard disk capacity	80MB	60MB	60MB	130MB	60MB	124MB	40MB
Microsoft Windows 3.1	□	□	■	■	■	□	■
Distribution channel	Dealers, superstores	Direct	Direct	Direct	Dealers, superstores	Direct	Dealers, direct
Dimensions (HWD, in inches)	1.7 x 11 x 8.5	2 x 11 x 8.5	1.5 x 11 x 8.5	1.6 x 11 x 8.5	2 x 11 x 8.5	2.2 x 12.5 x 11.2	1.7 x 12 x 10
Weight/travel weight (pounds)	6.1, 7.3	5, 6.6	5.9, 7.6	5.9, 7.6	6.5, 8	7.6, 9.3	6.4, 7.7
Display area (H x W, in inches)	5.5 x 7.5	6 x 8	6 x 7.5	5.5 x 7.5	5.5 x 7	6 x 8	5.5 x 7
Keys: total, function, cursor	80, 12, 4	84, 12, 4	84, 10, 4	84, 10, 4	85, 12, 10	79, 12, 4	84, 12, 8
Motherboard manufacturer	Compaq	ASIC	Twinhead	Twinhead	Jetta Computer	ASIC	Matsushita
Chip set manufacturer	Compaq	WD	VLSI	Intel	VLSI	WD	Headland
BIOS version (or date)	Compaq (Jan. 1992)	Phoenix 1.03	Phoenix 1.01	Phoenix 1 6	Award 3.1	Phoenix 1.01	Phoenix 3.1D
Setup in ROM/Password in ROM	■■	■■	□□	□□	□□	■□	□□
System shadowing/Video shadowing	■■	■■	■■	■■	■■	■□	□□
Memory and Disk Drives							
Installable RAM	4MB–10MB	4MB–16MB	2MB–6MB	4MB–20MB	2MB–16MB	4MB–8MB	2MB–8MB
User-installable	■	■	■	■	■	□	■
External processor RAM cache	16K	None	None	None	None	None	None
Available hard disk sizes	40MB, 60MB, 80MB	60MB	60MB, 80MB	130MB	60MB	60MB, 80MB, 124MB	40MB, 80MB
I/O and Expansion							
Parallel, serial, mouse ports	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
Proprietary expansion port	□	□	■	■	■	■	□
PCMCIA slot	□	□	□	□	□	□	□
Expansion unit	$929	□	□	□	□	$295, $1,195	□
Internal modem options	2,400-bps ($319), 9,600-bps data/fax ($599)	9,600-bps fax (included)	4,800-bps fax ($78), 9,600-bps fax ($193)	4,800-bps fax ($78), 9,600-bps fax ($193)	9,600-bps send-fax ($150)	9,600-bps fax ($395)	2,400-bps (included), 9,600-bps data/fax ($200)
Video							
Screen manufacturer	Compaq	Sharp	Sharp	Sharp	Hitachi	Seiko/Epson	Sharp
Maximum shades of gray	16	64	64	64	16	32	16
Video chip set manufacturer	Compaq	WD	Cirrus	Cirrus	Cirrus	WD	Cirrus
Simultaneous external display	■	■	■	□	□	□	□
Maximum external resolution	640 x 480 x 16	800 x 600 x 16	800 x 600 x 16	800 x 600 x 16	640 x 480 x 16	1,024 x 768 x 16	640 x 480 x 16
Maximum external colors	16	16	16	16	16	256	16
AC Adapter and Battery							
AC adapter size (inches)	1.4 x 3.3 x 5.3	2 x 2.5 x 3.5	1.8 x 3 x 6.5	1.8 x 3 x 6.5	2 x 3 x 7.5	2 x 3 x 6.5	1.8 x 2.8 x 5.5
Rated battery life (hours)	4.5	4	3	2.5	2	3	2.5
ZDigit, battery rundowns (hr:min)	3:26, 2:17	5:28, 1:31	3:26, 2:44	N/A, 2:12	2:18, 1:36	2:16, 1:42	3:26, 2:09
Charge time while on, off (hours)	1.5, 1	N/A, 1.5	6, 3	2, 1.5	N/A, 8	8, 3	1, 0.5
Battery weight, amp/hour rating	1.3 lbs, 2.2Ah	0.5 lbs, 1.4Ah	1.3 lbs, 1.7Ah	1.3 lbs, 1.7Ah	1.4 lbs, 5Ah	1.2 lbs, 1.7Ah	0.8 lbs, 1.4Ah
Display/hard disk power-down	■■	■■	□■	■■	■■	■■	■■
CPU/peripherals power-down	■■	■■	□□	■■	■■	■■	■■
Standby/Hibernation	■■	■□	■■	■□	□□	■■	■■

N/A—Not applicable: The product does not have this feature
ASIC—ASIC Design Inc., C&T—Chips & Technologies Inc., LES—Less Extensive Systems, MCC—Micro Computer Corp., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

Dell System NL25	Dell System 325N (PC Editors' Choice)	Epson NB-SL/20	Epson NB-SL/25	Everex Tempo Carrier 386SX/20	Gateway Nomad 325SXL
$2,626	$2,698	$3,127	$3,627	$3,127	$2,095
Intel 386SL/25	Intel 386SL/25	Intel 386SL/20	Intel 386SL/25	Intel 386SX/20	AMD Am386SXL/25
80MB	60MB	80MB	80MB	80MB	80MB
■	■	□	□	■	■
Direct, superstores, VARs	Direct, superstores, VARs	Dealers, superstores	Dealers, superstores	Dealers, superstores	Direct
1.5 x 11 x 8.3	2 x 11 x 8.5	2 x 11.5 x 9	2 x 11.5 x 9	1.8 x 11 x 8.5	2 x 11 x 8.5
6.3, 7.7	6.4, 7.6	7, 8.2	7.2, 9	5.3, 7	5.7, 7.1
6 x 7.5	6 x 7.5	6 x 7.7	6 x 7.7	6.2 x 10	6 x 8
85, 12, 4	85, 12, 4	84, 12, 4	84, 12, 4	80, 12, 4	79, 10, 4
Dell	Dell	Seiko/Epson	Sieko/Epson	Everex	TI
Intel	Intel	Intel	Intel	C&T	TI
Quadtel 3.06	Phoenix 1.01	Epson/Seiko/ Quadtel 1.51	Quadtel 3.06	AMI (Feb. 1988)	Phoenix 1.01
■■	■■	■■	■■	■■	■■
■■	■■	■□	■□	■■	■■
2MB–8MB	4MB–12MB	2MB–14MB	4MB–20MB	2MB–8MB	2MB–6MB
■	■	■	■	□	■
16K	64K	64K	64K	None	None
60MB, 80MB	60MB, 80MB, 120MB	40MB, 60MB, 80MB	40MB, 60MB, 80MB	40MB, 80MB	80MB
1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 2, 0	1, 1, 1
□	□	■	■	□	■
□	□	□	□	□	□
□	□	$899	$749	□	$698
9,600-bps send-fax ($149)	9,600-bps fax ($149), 9,600-bps fax ($299), 9,600-bps data/fax ($599)	9,600-bps fax ($249), 9,600-bps data/fax ($649)	9,600-bps fax ($249), 9,600-bps data/fax ($649)	9,600-bps send-fax ($329)	4,800-bps send-fax ($135), 9,600-bps data/fax ($365)
Sharp	Sharp	Hitachi	Epson	Sharp	Sharp
32	32	16	16	32	64
Intel	WD	Cirrus	Cirrus	C&T	Cirrus
□	□	■	■	□	□
800 x 600 x 16	800 x 600 x 16	640 x 480 x 16	640 x 480 x 16	640 x 480 x 16	800 x 600 x 16
256	256	16	16	16	256
3 x 4 x 5	3 x 4 x 5	1.5 x 3 x 6.5	1.5 x 3 x 6.5	1.8 x 2.6 x 5.9	1.5 x 2 x 6
2.5	3.5	3	2	2	2.5–6
3:26, 2:26	5:12, 3:02	3:29, 2:33	3:39, 2:17	2:31, 1:46	5:41, 3:34
N/A, 2.5	6, 3.5	N/A, 1.5	N/A, 3.5	1.5, 1.5	4, 3
1.3 lbs, 1.7Ah	1.6 lbs, 2.2Ah	0.7 lbs, 1.7Ah	0.7 lbs, 1.7Ah	0.7 lbs, 2.4Ah	1.3 lbs, 5.7Ah
■■	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■
■■	■■	■□	■□	■■	■□

CONTINUES

measures 2 by 11 by 8 inches and weighs 6.1 pounds with its nickel cadmium battery. Our test unit had 4MB of 80-nanosecond RAM (user-expandable to 6MB maximum), a coprocessor socket, a 19-millisecond 127MB Seagate ST9144A hard disk, a 1.44MB floppy disk drive manufactured by Y.E. Data, DOS 5.0, and Microsoft Windows 3.0. Parallel, serial, external VGA, and PS/2 mouse ports are on the left; a keyboard connector is on the right. A user-installable internal modem is optional, and 2MB memory upgrades cost $299 each. The display subsystem consists of a 10-inch sidelit triple-supertwist VGA-compatible Sharp screen powered by a Western Digital WD90C20-LR chip set with 1MB of 80-ns video RAM.

Performance was average on the processor test but better on the memory test. Disk performance was good compared with other 20-MHz systems. Video scores were in the top quarter of this test group. Its battery life was 2 hours 29 minutes on our Battery Rundown test and 3 hours 12 minutes under test conditions simulating normal use.

The system is put together well and comes with good documentation. The 79-key keyboard is comfortable to use but lacks dedicated Home, End, PgUp, and PgDn keys.

Texas Instruments warrants its notebooks for one year on parts and labor. On-site service is available for the first year for $199; alternatively, the company accepts units for repair and mirror-ships them back. Technical support is available but is not toll-free.—*WPF*

FACT FILE

TI TravelMate 3000 WinSX

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; 800-527-3500, 214-995-2011; fax, 214-995-4360

List price (tested configuration): $3,599.
Tested Configuration: 4MB RAM, 120MB Seagate hard disk, 1.44MB floppy disk drive, DOS 5.0.
Options: 2MB RAM upgrade, $299; numeric keypad, $69; docking station, $999; extra battery, $99; Ethernet network adapter, $499; Token-Ring network adapter, $999; SCSI adapter, $399; 9,600-bps MNP 5 send-fax modem, $299; 9,600-bps V.42bis data/fax modem, $899; carrying case, $69.

530 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Companies listed in alphabetical order ■ = YES □ = NO	Gateway Nomad 420SXL	Gateway Nomad 425DXL	Identity 386SX/20 Notebook	Insight 386-25SXL Notebook	Intelec Halikan 386SX/20	KRIS Master 386SX/25	Matrix 386SX/20 Notebook
List price (tested configuration)	$2,795	$3,495	$3,495	$1,949	$1,768	$1,795	$1,949
Processor type and speed	Intel 486SX/20	Intel 486DX/25	Intel 386SX/20	AMD Am386SXL/25	Intel 386SX/20	AMD Am386SXL/25	Intel 386SX/20
Hard disk capacity	80MB	120MB	124MB	80MB	80MB	80MB	60MB
Microsoft Windows 3.1	■	■	■	□	■	■	□
Distribution channel	Direct	Direct	Dealers, superstores	Direct	Direct	Dealers, OEMs, VARs	Dealers
Dimensions (HWD, in inches)	2 x 11 x 8.5	2 x 11 x 8.5	2.2 x 11 x 8.5	2 x 11 x 8.5	2 x 11.7 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5
Weight/travel weight (pounds)	5.8, 7.2	5.8, 7.2	6.4, 7.7	5.7, 7.1	6.5, 8.3	6.7, 8.5	7.3, 8.9
Display area (H x W, in inches)	6 x 8	6 x 8	5 x 7	6 x 8	5 x 7	5.5 x 7	5.5 x 7
Keys: total, function, cursor	79, 10, 4	79, 10, 4	80, 12, 4	79, 10, 4	80, 12, 4	80, 12, 4	79, 12, 4
Motherboard manufacturer	TI	TI	Cirrus	Insight	Chaplet	Compal	Matrix
Chip set manufacturer	TI	TI	Phoenix	VLSI	Intel	VLSI	Intel
BIOS version (or date)	Phoenix 0.98	Phoenix 0.98	Phoenix 1.01	Phoenix 1.01	AMI 1.30	Phoenix 1.01	Award 3.04D
Setup in ROM/Password in ROM	■□	■□	□□	■■	■■	■■	■■
System shadowing/Video shadowing	■■	■■	■■	■■	■■	■■	■■
Memory and Disk Drives							
Installable RAM	4MB–20MB	4MB–20MB	1MB–5MB	2MB–8MB	1MB–4MB	2MB–16MB	2MB–8MB
User-installable	■	■	■	□	■	■	■
External processor RAM cache	None	None	None	None	None	None	None
Available hard disk sizes	80MB	120MB	60MB, 80MB, 124MB	40MB, 80MB, 130MB	40MB, 60MB, 80MB, 120MB	40MB, 60MB, 80MB, 130MB	60MB, 120MB
I/O and Expansion							
Parallel, serial, mouse ports	1, 1, 1	1, 1, 1	1, 1, 0	1, 1, 1	1, 1, 0	1, 1, 0	1, 1, 1
Proprietary expansion port	■	■	□	□	■	■	□
PCMCIA slot	□	□	□	□	□	□	□
Expansion unit	$698	$698	□	□	$329	$360	$439
Internal modem options	4,800-bps send-fax ($135), 9,600-bps data/fax ($365)	4,800-bps send-fax ($135), 9,600-bps data/fax ($365)	None	2,400-bps ($125), 9,600-bps fax ($199)	None	2,400-bps ($165), 9,600-bps V.42bis fax ($335)	9,600-bps send-fax ($165)
Video							
Screen manufacturer	Sharp	Sharp	Sanyo	Sharp	Epson	Sharp	Sharp
Maximum shades of gray	64	64	16	64	16	16	32
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus	Cirrus
Simultaneous external display	■	■	□	■	□	□	□
Maximum external resolution	1,024 x 768 x 16	1,024 x 768 x 16	640 x 480 x 16	640 x 480 x 256	640 x 480 x 16	640 x 480 x 16	1,024 x 768 x 16
Maximum external colors	256	256	16	256	16	16	256
AC Adapter and Battery							
AC adapter size (inches)	1.5 x 2 x 6	1.5 x 2 x 6	1.8 x 3 x 5	1.8 x 3 x 4.5	2 x 3.5 x 7	2.3 x 3 x 6.5	2 x 3 x 7.5
Rated battery life (hours)	2.5–6	2.5–6	2	2–3	2	3	2.5
ZDigit, battery rundowns (hr:min)	4:34, 3:41	4:34, 3:41	2:18, 1:45	2:18, 1:45	2:30, 1:53	3:12, 2:41	4:20, 3:06
Charge time while on, off (hours)	4, 3	4, 3	8, 4	12, 3–4	6, 3	N/A, 3	N/A, 3
Battery weight, amp/hour rating	1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.1 lbs, 2.8Ah	0.7 lbs, 1.7Ah	1.3 lbs, 2.5Ah	1.4 lbs, 5Ah	1.4 lbs, 5Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	■■	■■	■□	□□	■■	■□
Standby/Hibernation	■□	■□	■■	■■	□□	■■	■□

N/A—Not applicable. The product does not have this feature
ASIC—ASIC Design Inc., C&T—Chips & Technologies Inc., LES—Less Extensive Systems, MCC—Micro Computer Corp.,
SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digita

Micro Express NB913 Notebook PC	Micro Express NB925	Micro Express NB2500 Notebook	MicroStar NoteStar NP-913 386SX/20	MicroStar NoteStar NP-925 386SX/25	Mitsuba Ninja 386SX/20
$2,219	$2,379	$2,925	$2,217	$2,277	$1,859
AMD Am386SXL/20	Intel 386SX/25	AMD Am386DXL/25	Intel 386SX/20	Intel 386SX/25	Intel 386SX/20
120MB	120MB	120MB	120MB	120MB	60MB
■	■	■	■	■	□
Direct	Direct	Direct	Dealers	Dealers	Dealers
2 x 11.5 x 9.5	2 x 12.5 x 9.5	2.5 x 11 x 8.2	2.1 x 12.2 x 9.5	2.1 x 12.2 x 9.5	2 x 11 x 8.7
7.9, 9.5	8, 9.5	7.4, 9.1	7.9, 10.2	7.9, 10.2	7.3, 9
6 x 8	5.5 x 7.5	7 x 8.5	6 x 8	5.5 x 7.5	5.2 x 7
83, 12, 4	83, 10, 4	84, 12, 4	83, 12, 4	83, 10, 4	78, 12, 4
Micro Express	Micro Express	Micro Express	Citizen	Citizen	Quantum
C&T, Headland	C&T	SIS, Acer	Headland	Headland	Intel
AMI 1.13	AMI 1.13	AMI (June 1990)	AMI 1.13	AMI 1.13	AMI 3 04D
■□	□□	■□	■□	□□	■■
■■	■■	■■	■■	■■	■■
2MB–8MB	2MB–8MB	2MB–8MB	1MB–8MB	1MB–8MB	2MB–8MB
□	□	□	■	■	■
None	None	128K	None	None	None
60MB, 80MB, 120MB	60MB, 80MB, 120MB	60MB, 80MB, 120MB	20MB, 40MB, 60MB, 80MB, 130MB	20MB, 40MB, 60MB, 80MB, 130MB	60MB, 80MB, 120MB
1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 0	1, 1, 1
■	■	■	■	■	■
□	□	□	□	□	□
□	$299	$499	□	□	$515
2,400-bps ($250), 9,000-bps fax ($350)	2,400-bps ($250), 9,000-bps fax ($350)	9,600-bps fax (included)	9,600-bps fax ($186)	9,600-bps fax ($186)	9,600-bps fax ($175)
Sanyo	Sanyo	Sanyo	Sanyo	Sanyo	Sharp
64	64	64	64	64	16
C&T	C&T	Cirrus	Headland	Headland	Cirrus
■	□	□	■	□	□
800 x 600 x 16	800 x 600 x 16	640 x 480 x 256	640 x 480 x 16	640 x 480 x 16	800 x 600 x 16
16	16	256	16	16	256
1.5 x 3 x 6.5	1.5 x 3 x 6.5	1.5 x 3 x 6.5	1.8 x 3 x 6.8	1.8 x 3 x 6.8	2 x 3 x 7.5
2.5	2.5	3	2.5	2.5	3.5
4:20, 3:20	4:06, 2:56	2:31, 2:28	4:34, 3:34	4:48, 3:09	4:07, 2:02
8, 6	8, 6	7.5, 2.5	8, 6	8, 6	N/A, 2.5
1 lb, 2.8Ah	1 lb, 5Ah	1.3 lbs, 2Ah	1 lb, 2.8Ah	1 lb, 2.8Ah	1.4 lbs, 5Ah
■■	■■	■■	■■	■■	■■
■□	■□	□□	■□	■□	■□
□□	□□	□□	□□	□□	■□

CONTINUES

Toshiba America Information Systems Inc.

Toshiba T4400SX
Toshiba T3300SL
Toshiba T2200SX

If a 486 is what you want, the Toshiba T4400SX is worth serious consideration. It costs $5,599 with a gas-plasma screen or a $5,299 with an LCD; the $7,699 Toshiba T4400SXC, reviewed in the next section, offers active-matrix color. These notebooks offer competitive performance, but their construction and features have been polished to a military shine.

Based on a 25-MHz Intel 486SX, the light-gray Toshiba T4400SX measures 2 by 11.5 by 8.3 inches and weighs 7.5 pounds with its nickel cadmium battery. Our test unit came with 6MB of RAM (2MB standard, user-expandable to 10MB; Toshiba says that a 16MB module will be available in June). This notebook lacks a coprocessor slot but has a 19-millisecond 85MB Conner CP-2084 IDE hard disk, a 1.44MB floppy disk drive mounted in a side slot, and a standard complement of I/O ports beneath a pleasantly rugged plastic door.

Both the 9.5-inch monochrome Sharp supertwist sidelit LCD and the 9.5-inch Matsushita gas-plasma units are driven by a Western Digital WD90C23 chip set with 256K of video RAM. The video subsystem can display 16 shades of gray at 640-by-480 resolution and can drive an external display simultaneously.

The Toshiba T4400SX's performance was midrange on all of our benchmark tests among 486-based systems, but exceptional for the entire class. Its battery life on our Battery Rundown test was 3 hours 12 minutes for the plasma version and 3 hours 40 minutes for the LCD version. With power-conservation features enabled for our ZDigit Rundown test, the plasma-screen model lasted 3 hours 55 minutes; the LCD version, 4 hours 19 minutes.

The Toshiba T4400SX is solidly built, like the other Toshibas in this review. Monochrome video is great for DOS, though most will prefer the LCD's gray Windows presentation over the gas plasma's glaring orange. The cursor keys

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Jim Seymour
PC Week, May 4 '92

"There are lots of good brands on the market, but the Z▪NOTE stands out."
Wall Street Journal
May 13 '92

"BEST OF SHOW"
BYTE Magazine
Spring COMDEX '92

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Christopher Stetson
PC Week, May 11 '92

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Wayne Rash Jr
Corporate Computing
July '92

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—Walter S. Mossberg
Wall Street Journal/May 13 '92

intel inside

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Our high-contrast black-on-white display is upgradeable to brilliant active-matrix color. It's a dream come true.

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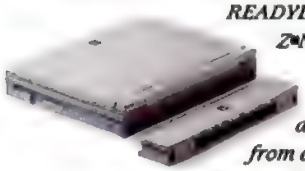

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—Jim Seymour
PC Week/May 4 '92

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Z•NOTE	320L	325L	325Lc
Processor/MHz	i386SL™/20	i386SL/25	i386SL/25
Hard Drive	60MB	85/120MB	120MB
Memory (Std/Max)	2/12MB	4/12MB	4/12MB
Video Display (Viewable)	9.5" VGA black-on-white	9.5" VGA black-on-white	8.4" VGA Active matrix color
NiMH Battery Life*	4-10 hours	4-10 hours	2.5-6.5 hours
Weight	5.9 lbs.	5.9 lbs.	6.5 lbs.
Price	$2599	$3099/3599	$5299

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†Anticipated availability July 1992. All models subject to availability. *Battery life depends on application used, power management features selected and peripherals attached. All prices and specifications are subject to change. Prices are for models shown in U.S. dollars. Shipping, handling and applicable sales taxes not included in the price. Warranty information available upon request. Z•NOTE, READYDESK and Premier System Management are trademarks of Zenith Data Systems Corporation. Microsoft Windows, MS-DOS and the Ready-To-Run logo are trademarks of Microsoft Corporation. Logitech and TrackMan are trademarks of Logitech, Inc. The Intel Inside logo, i386 and i387 are trademarks of Intel Corporation. Copyright © 1992 Zenith Data Systems Corporation.

CIRCLE 271 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Companies listed in alphabetical order ■ = YES □ = NO	NBCC 386SL/20	NCR Safari NSX/20	NCR System 3170	NEC UltraLite SL/20	NEC UltraLite III	Olivetti Notebook S20	Packard Bell 386SX/20 Notebook
List price (tested configuration)	$2,195	$3,449	$5,399	$3,268	$2,968	$2,919	$1,999
Processor type and speed	Intel 386SL/20	Intel 386SX/20	Intel 386SL/25	Intel 386SL/20	Intel 386SX/20	AMD Am386SXL/25	Intel 386SX/20
Hard disk capacity	40MB	80MB	80MB	80MB	60MB	64MB	80MB
Microsoft Windows 3.1	□	■	■	■	■	■	■
Distribution channel	Dealers	Dealers	Dealers	Dealers	Dealers	Direct	Dealers
Dimensions (HWD, in inches)	2.5 x 12 x 8.5	2 x 12 x 9.5	2 x 11 x 8	2.5 x 11.5 x 9.5	1.5 x 11.5 x 9	2 x 11.5 x 8.2	2 x 11 x 8.5
Weight/travel weight (pounds)	7.1, 8.8	7.2, 8.3	5.2, 6.6**	6.4, 7.9	4.7, 5.8***	7, 8.6	7, 8.6
Display area (H x W, in inches)	6 x 7.5	6 x 8	6 x 7.5	6 x 7.5	6 x 7.8	5 x 7	5.5 x 7
Keys: total, function, cursor	82, 10, 4	82, 12, 4	78, 10, 3	78, 12, 4	78, 12, 4	83, 10, 8	80, 12, 4
Motherboard manufacturer	NBCC	Matsushita	Matsushita	NEC	NEC	Olivetti	Packard Bell
Chip set manufacturer	AT&T, C&T	Headland	Intel	Intel	Intel	VLSI	C&T
BIOS version (or date)	Quadtel 3.00	Phoenix 1.01	Phoenix 1.01	Phoenix 1.01 (April 1990)	Phoenix 1.01	Olivetti	Award 3.04D
Setup in ROM/Password in ROM	■ ■	■ ■	■ ■	□ ■	■ ■	■ ■	■ ■
System shadowing/Video shadowing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Memory and Disk Drives							
Installable RAM	2MB–8MB	4MB–8MB	2MB–20MB	2MB–8MB	2MB–10MB	2MB–6MB	4MB–8MB
User-installable	■	□	■	□	□	■	■
External processor RAM cache	16K	None	64K	16K	None	None	None
Available hard disk sizes	40MB, 60MB, 80MB, 120MB	40MB, 80MB	80MB, 120MB	80MB, 125MB	60MB	64MB	80MB
I/O and Expansion							
Parallel, serial, mouse ports	1, 1, 0	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
Proprietary expansion port	■	■	■	■	■	■	■
PCMCIA slot	□	□	■	□	□	□	□
Expansion unit	$795	$525	$899	$999	$999	$640	□
Internal modem options	9,600-bps fax ($275)	9,600-bps fax (included), 14,400-bps data/ fax ($999)	14,400-bps data/ 9,600-bps fax (included)	2,400-bps ($299), 9,600-bps fax ($449)	9,600-bps MNP 5 fax ($499)	2,400-bps ($225), 9,600-bps fax ($375)	9,600-bps send-fax (included)
Video							
Screen manufacturer	Sharp	Sharp	Matsushita	NEC	NEC	Seiko/Epson	Packard Bell
Maximum shades of gray	32	32	32	16	16	32	32
Video chip set manufacturer	Cirrus	Cirrus	Cirrus	WD	WD	Cirrus	Cirrus
Simultaneous external display	□	□	□	□	□	□	□
Maximum external resolution	800 x 600 x 16	640 x 480 x 256	640 x 480 x 256	640 x 480 x 16	640 x 480 x 256	800 x 600 x 16	640 x 480 x 256
Maximum external colors	256	256	256	16	256	16	256
AC Adapter and Battery							
AC adapter size (inches)	1.5 x 2 x 4.5	1.8 x 2.8 x 5.1	2 x 3 x 6	1.5 x 3.5 x 6.5	1.5 x 3.5 x 6.5	2 x 3.3 x 6.5	1.5 x 3 x 7.5
Rated battery life (hours)	3	4–6	3	3	2	4	3
ZDigit, battery rundowns (hr:min)	2:44, 2:02	5:15, 4:06	1:50, 1:38	3:45, 2:05	1:50, 1:45	2:45, 2:34	3:40, 2:34
Charge time while on, off (hours)	5–7, 1	6, 6	N/A, 1.5	15, 3	8, 1	N/A, 3	N/A, 3
Battery weight, amp/hour rating	0.8 lbs, 1.2Ah	0.8 lbs, 1.4Ah	0.8 lbs, 1.4Ah	1 lb, 1.7Ah	0.7 lbs, 1.7Ah	1.7 lbs, 1.8Ah	1.4 lbs, 5Ah
Display/hard disk power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
CPU/peripherals power-down	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □
Standby/Hibernation	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ □

N/A—Not applicable. The product does not have this feature **The NCR System 3170's weight does not include the 1-pound external floppy disk drive
***The NEC UltraLite III's weight does not include the 1.2-pound external floppy disk drive
ASIC—ASIC Design Inc., C&T—Chips & Technologies Inc., LES—Less Extensive Systems, MCC—Micro Computer Corp.,
SiS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

PC Brand 386SX-25 Notebook	Poly Notebook 320T	Positive PC320ND	Proteus 386-20NB	Sanyo MBC-18NB6H	Sharp PC-6781 Notebook
$1,944	$2,379	$2,299	$1,895	$3,749	$3,898
Intel 386SX/25	Intel 386SX/20	Intel 386SX/20	Intel 386SX/20	Intel 386SX/20	Intel 386SL/20
60MB	130MB	60MB	60MB	60MB	80MB
■	■	■	■	□	□
Direct	Direct	Dealers	Dealers, direct	Dealers	Dealers
1.5 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	2 x 11.5 x 8	2 x 12 x 10	1.6 x 11 x 8.5
7, 8.8	6.9, 8.7	6.9, 8.7	6, 7.1	7, 8.8	4.9, 6.2
5.5 x 7.3	5.3 x 7	5.5 x 7	5.5 x 7	6 x 8	6 x 8
81, 12, 4	80, 12, 4	80, 12, 4	85, 12, 4	82, 12, 4	79, 12, 4
PC Brand	LES	Compal	Vysotec	Sanyo	Sharp
Intel	VLSI	Intel, VLSI	WD	Oak Technology	Intel
PC Brand (Jan. 1992)	Phoenix 1.00	IBM (Dec. 1991)	AMI 1.0	Phoenix 1.10	Phoenix (April 1990)
■■	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■
2MB–16MB	4MB–16MB	2MB–16MB	2MB–5MB	1MB–5MB	2MB–8MB
■	■	■	■	□	■
None	None	None	None	None	16K
30MB, 80MB, 120MB	40MB, 130MB	40MB, 60MB, 80MB, 120MB	60MB, 80MB, 120MB, 230MB	60MB	80MB
1, 2, 0	1, 2, 0	1, 1, 0	1, 1, 1	1, 1, 0	1, 1, 0
■	■	■	■	□	■
□	□	□	□	□	■
$369	$380	□	$199	□	$999
2,400-bps ($119), 9,600-bps MNP 5 fax ($249)	2,400-bps ($165), 9,600-bps fax ($300)	9,600-bps fax (included)	9,600-bps fax ($295)	2,400-bps ($390)	2,400-bps MNP 5 data/fax ($499)
Sharp	Toshiba	Sharp	Hitachi	Sanyo	Sharp
32	32	16	16	8	32
C&T	Cirrus	Cirrus	WD	WD	WD
□	□	□	■	□	□
800 x 600 x 16	640 x 480 x 16	800 x 600 x 16	800 x 600 x 16	640 x 480 x 16	800 x 600 x 16
16	16	16	16	16	16
2 x 3 x 6.3	2 x 3 x 6.5	2 x 3 x 6.3	1.5 x 2.1 x 5	2 x 3 x 8	1.4 x 3.5 x 6.4
3	3	2	1	2	1.5
2:45, 2:28	3:52, 3:07	2:32, 2:02	1:24, 1:14	3:39, 2:15	2:04, 1:47
N/A, 2	N/A, 2.5	N/A, 3	8, 1	8, 1	8, 2
1.4 lbs, 5Ah	1.4 lbs, 4.5Ah	1.4 lbs, 4.5Ah	0.7 lbs, 1.7Ah	1.1 lbs, 1.7Ah	0.8 lbs, 1.8Ah
■■	■■	■■	■■	■■	■■
■□	□■	■■	■□	■■	■■
■□	■□	■□	■□	■□	■■

CONTINUES

are in an inverted-T layout with separate Home, End, PgUp, and PgDn keys, but the function keys are half-size. Keyboard-only Windows users will have to relearn certain finger movements. This minor knock aside, the Toshiba T4400SX is a well-designed package.

TOSHIBA T3300SL, TOSHIBA T2200SX

The slim, solid, $3,999 Toshiba T3300SL and $3,499 Toshiba T2200SX fully live up to Toshiba's rock-solid reputation in the laptop market. If a speedy, practical notebook is what you're looking for, these would fill the bill.

The 6-pound, 8.5- by 11.5- by 1.5-inch Toshiba T3300SL comes with 2MB of RAM standard (expandable up to 18MB via 2MB, 4MB, 6MB, and 16MB credit-card-size expansion modules. Based on a 25-MHz Intel 386SL processor, our test unit came with a 16-millisecond 80MB JVC hard disk (a 120MB unit is also available), a side-mounted 1.44MB floppy disk drive, an 82-key keyboard, and all the requisite ports (except PS/2 mouse) behind a rugged plastic door. The video

SUITABILITY TO TASK

Toshiba T4400SX (LCD)

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Toshiba T4400SX (plasma)

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Toshiba T3300SL

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

Toshiba T2200SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

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AUTOMAP EUROPE takes the trouble out of travel planning - wherever you're going in Europe. Instead of fumbling with road maps (especially foreign road maps), you can print out and pack along your own customized driving guide: complete with mileage charts and travel times. Features (zoom in/zoom out capability) of 250,220 miles of European motorways. Also includes street maps to 8,497 cities, townships and villages.
Publisher: AUTOMAP, Inc. BS6504 $79.

AUTOMAP

AUTOMAP helps you find the best route for your trip. It's fast, fun and informative with hundreds of up-to-date color maps. It searches its database of nearly 400,000 miles of roads and even lists alternate routes and prints a map for you. AUTOMAP's driving instructions list all the roads you'll be traveling, exactly how far to go, exactly where to turn and the signs to look for.
Publisher: AUTOMAP, Inc. BS5224

$50

★FontMonger for Windows

FontMonger bridges competing font technologies by letting desktop publishers easily convert between Adobe PostScript Type 1 and Type 3, Intellifont, Nimbus Q and TrueType (for Windows 3.1). Converted fonts can be saved for IBM PC and compatibles, Macintosh and NeXT computers. FontMonger lets you modify character outlines with built in drawing tools or generate customized typefaces and characters such as obliques, fractions and small caps. Copy and paste characters to create a new font. **Publisher: ARES GR3074**

$98

Stacker 2.0

Stacker 2.0, the award-winning data compression software from Stac Electronics, instantly and safely doubles the disk capacity of your DOS-based personal computer by compressing and decompressing your data without losing any information. Ideal for laptop and notebook computers, Stacker uses transparent instantaneous compression to free valuable memory, letting you load additional programs and data. It's fully compatible with DOS and Windows programs and can even double the capacity of removable storage devices like floppy disks, Bernoulli disks and Syquest cartridges. Anyone can install Stacker in minutes. You simply insert the disk and run the easy-to-use installation program. That's all it takes to double your disk capacity!
Publisher: Stac Electronics EX1480

$99

★Aldus® Gallery Effects™

Aldus Gallery Effects is a library of artistic effects that automatically transforms grayscale or color scanned photographs and other bitmap images into stunning, sophisticated works of art. Use Gallery Effects' plug-in filters directly in programs like Aldus PhotoStyler, or use the separate application. Sixteen master effects, including Graphics Pen, Watercolor, Emboss, and Charcoal. Thousands of variations from each effect. A "must have" for any scanner user. **Publisher: Aldus GR5294**

$139

The UnMouse

The UnMouse does everything a mouse can—only faster, easier, and in less space. To move the cursor, simply slide your finger over the glass surface. To make a selection merely press down. The UnMouse also serves as an extended keyboard. Tap the large red button and you have a Power Keypad with 16 keys instantly available to execute macros (60 in advanced mode). With its one million touch points the UnMouse also performs as a small graphics tablet.
Manufacturer: Microtouch IN0810

$165

★Aldus® PhotoStyler™

Aldus PhotoStyler is the most powerful and versatile Windows color image processing program available for the creative professional. It lets you acquire photographic images from a wide range of sources and in many industry-standard file formats, and then enhance them or modify them for use in publications or presentations. You can even create original images using PhotoStyler's extensive painting and effects tools.
Publisher: Aldus GR5034 $529.

Anyone who buys PhotoStyler, FreeHand, PageMaker, or Persuasion will receive a Free Gallery Effects when they complete and mail their product registration. Offer expires 7/31/92

★Aldus® FreeHand™

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Bernoulli PC Powered PRO is the Data Storage System that provides endless, affordable growth that expands and changes as your needs do. Perfect for storage-intensive Windows and desktop publishing applications, the Bernoulli PC Powered offers 90MB of high-performance on-line storage capacity with hard-disk-like performance (19 msec effective access time, 9 msec with included speed cache software). Includes SCSI port and Central Point Software. Backing up is as simple as making disk-to-disk copies. And unlike tape drives, Bernoulli backups are ready to use without a restore operation.
Manufacturer: Iomega DR2360

$625

UPDATE

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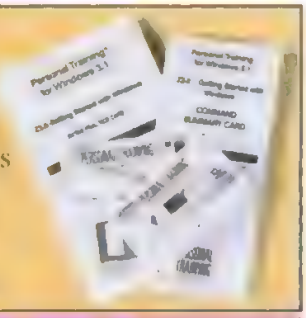

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$479

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Also available: *Luppac 5 Midsize Case* AC3360 $48.
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IHH094

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ED3454

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Manufacturer: MARCO International

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Publisher: Adobe
GR514-3/5

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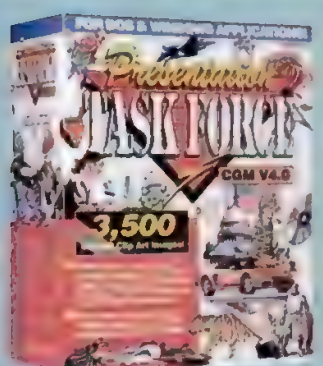

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GR317-4

$134

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Publisher: Berkeley Systems
GR199-4

$29

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▶ SUMMARY OF FEATURES

Companies listed in alphabetical order

■ = YES □ = NO

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List price (tested configuration)	$2,185	$2,514	$2,999	$3,499	$2,199	$2,095	$3,599
Processor type and speed	AMD Am386SXL/20	AMD Am386SXL/25	Intel 386SL/25	Intel 486DX/33	AMD Am386SXL/25	AMD Am386SXL/25	Intel 386SX/20
Hard disk capacity	60MB	80MB	80MB	60MB	124MB	80MB	120MB
Microsoft Windows 3.1	■	■	■	■	■	■	■
Distribution channel	Dealers	Dealers	Company-owned stores, dealers	Company-owned stores, dealers	Dealers, OEMs, VARs	Direct, VARs	Dealers, superstores
Dimensions (HWD, in inches)	2.1 x 11 x 8.5	1.8 x 11 x 8.5	2 x 11 x 8.5	2 x 11 x 8.5	1.7 x 12 x 9.5	2 x 11 x 8.5	2 x 11 x 8.5
Weight/travel weight (pounds)	7, 8.8	5.8, 6.9	5.9, 7.1	5.8, 7.5	7.9, 9.4	6.3, 8	6, 7.8
Display area (H x W, in inches)	6 x 8	6 x 8	6 x 8	6 x 7.5	6 x 7.5	6 x 7.5	6 x 8
Keys: total, function, cursor	80, 10, 4	80, 10, 4	84, 10, 4	84, 10, 4	84, 10, 4	82, 10, 4	79, 12, 4
Motherboard manufacturer	Samsung	Samsung	Matsushita	Twinhead	Modern Computer	Sampo	TI
Chip set manufacturer	C&T	C&T	Intel	Intel	Acer, Headland	VLSI	TI
BIOS version (or date)	C&T 2.1	C&T 2.1	Phoenix 1.1	Phoenix 1.1	AMI (June 1990)	Phoenix (Jan. 1988)	Phoenix 1.01
Setup in ROM/Password in ROM	■□	■□	■□	■□	□□	■■	■■
System shadowing/Video shadowing	■■	■■	■■	■■	■■	■■	■■
Memory and Disk Drives							
Installable RAM	1MB–8MB	1MB–8MB	2MB–8MB	4MB–20MB	2MB–8MB	4MB–8MB	4MB–6MB
User-installable	■	■	■	■	■	■	□
External processor RAM cache	None	None	16K	8K	None	None	None
Available hard disk sizes	40MB, 60MB, 120MB	40MB, 80MB, 120MB	80MB	60MB	80MB, 124MB	60MB, 80MB	60MB, 80MB
I/O and Expansion							
Parallel, serial, mouse ports	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 0	1, 1, 0	0, 1, 0	1, 1, 1
Proprietary expansion port	■	■	■	□	■	■	■
PCMCIA slot	□	□	□	□	□	□	■
Expansion unit	□	□	$699	□	□	□	$999
Internal modem options	2,400-bps ($199), 9,600-bps fax ($299)	2,400-bps ($199), 9,600-bps fax ($299)	9,600-bps fax ($199.95)	9,600-bps fax ($199.95)	2,400-bps ($110), 2,400-bps MNP 5 ($150), 9,600-bps fax ($150)	4,800-bps fax (included)	9,600-bps send-fax ($299), 9,600-bps v.42bis data/fax ($899)
Video							
Screen manufacturer	Samsung	Samsung	Sharp	Sharp	Sanyo	Sharp	Sharp
Maximum shades of gray	64	64	64	64	64	32	32
Video chip set manufacturer	C&T	C&T	Cirrus	Cirrus	C&T	Cirrus	WD
Simultaneous external display	■	■	■	■	□	□	■
Maximum external resolution	640 x 480 x 256	640 x 480 x 256	800 x 600 x 16	800 x 600 x 16	800 x 600 x 16	800 x 600 x 16	1,024 x 768 x 256
Maximum external colors	256	256	16	16	16	256	256
AC Adapter and Battery							
AC adapter size (inches)	2 x 3.5 x 5.7	1.8 x 3.2 x 4.7	1.5 x 2.5 x 5.5	1.3 x 3 x 6.5	1.5 x 3 x 7	2 x 3.3 x 5.8	2 x 3.5 x 5.8
Rated battery life (hours)	2.5	2.5	3	2.5–3	3–5	3	3–4
ZDigit, battery rundowns (hr:min)	3.52, 2:39	2:04, 1:36	N/A, 2:39	2:23, 2:15	4:20, 3:48	5:15, 3:25	3:12, 2:29
Charge time while on, off (hours)	4, 3	4, 3	5, 2	5, 2	3–5, 3	10, 2	18, 4–5
Battery weight, amp/hour rating	1.4 lbs, 5Ah	0.8 lbs, 1.7Ah	0.9 lbs, 1.4Ah	1.3 lbs, 1.7Ah	1 lb, 2.8Ah	1.1 lbs, 2.8Ah	1.2 lbs, 1.2Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■□	■□	■■	■■	■□	□□	■■
Standby/Hibernation	■■	■■	■□	■□	■□	■□	■□

N/A—Not applicable. The product does not have this feature
ASIC—ASIC Design Inc., C&T—Chips & Technologies Inc., LES—Less Extensive Systems, MCC—Micro Computer Corp., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., VLSI—VLSI Technology Inc., WD—Western Digital

	Toshiba T2200SX	Toshiba T3300SL	Toshiba T4400SX (plasma)	Toshiba T4400SX (LCD)	Transource Verxion 386SX/20
	$3,978	$3,999	$5,599	$5,299	$1,655
	Intel 386SX/20	Intel 386SL/25	Intel 486SX/25	Intel 486SX/25	Intel 386SX/20
	80MB	80MB	80MB	80MB	64MB
	☐	☐	☐	☐	■
	Dealers	Dealers, VARs	Dealers	Dealers	Dealers, direct
	1.5 x 11 x 8.5	1.5 x 11.5 x 8.5	2 x 11.5 x 8.2	2 x 11.5 x 8.2	2 x 12 x 8
	5.6, 6.9	5.7, 7.1	7.5, 9.4	7.5, 9.4	6.8, 7.1
	5 x 7	5.5 x 7.5	6 x 7.5	6 x 7.5	6 x 8
	82, 12, 8	82, 12, 8	82, 12, 4	82, 12, 4	83, 12, 4
	Toshiba	Toshiba	Toshiba	Toshiba	Top PC
	Toshiba	Toshiba	Toshiba	Toshiba	Headland
	Toshiba 1.2	Toshiba 1.2	Toshiba 1.2	Toshiba 1.2	AMI (April 1991)
	■☐	■☐	■■	■■	■■
	■■	■■	■■	■■	■■
	2MB–8MB	2MB–16MB	2MB–16MB	2MB–16MB	1MB–4MB
	■	■	■	■	☐
	None	64K	None	None	None
	40MB, 60MB, 80MB	80MB, 120MB	80MB, 120MB	80MB, 120MB	80MB, 100MB
	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
	■	■	■	■	☐
	☐	■	☐	☐	☐
	$969	$999	$999	$999	☐
	2,400-bps MNP 5 ($459)	2,400-bps MNP 5 ($459)	2,400-bps ($199), 2,400-bps V.42bis ($259)	2,400-bps ($199), 2,400-bps V.42bis ($259)	None
	Toshiba	Toshiba	Matsushita	Toshiba	Hitachi
	32	32	16	64	16
	WD	WD	WD	WD	Cirrus
	☐	☐	■	■	☐
	640 x 480 x 256	640 x 480 x 256	640 x 480 x 256	640 x 480 x 256	800 x 600 x 16
	256	256	256	256	256
	1 x 3 x 5.5	1 x 3 x 5.5	1 x 3 x 5.5	1 x 3 x 5.5	2 x 3 x 5.5
	3.5	3	3	3	3
	4:06, 3:22	3:40, 3:37	3:55, 3:12	4:19, 3:40	3:12, 2:34
	N/A, 2	N/A, 2	4, 1.5	4, 1.5	4, 2
	1.5 lbs, 2.2Ah	1.4 lbs, 2.2Ah	2.3 lbs, 2.4Ah	2.3 lbs, 2.4Ah	0.7 lbs, 5.6Ah
	■■	■■	■■	■■	■■
	■■	■■	■■	■■	☐☐
	■■	■■	■☐	■☐	■☐

ENDS

subsystem consisted of a 9.5-inch Toshiba backlit LCD powered by a Western Digital WD90C23 chip set with 256K of video RAM.

The Toshiba T2200SX, 5.6 pounds with its 1.45-pound nickel hydride battery, comes in the same case as the Toshiba T3300SL with 2MB of RAM standard (16MB maximum), a 19-ms 80MB Conner CP-2084 IDE hard disk (the only size presently available), a 1.44MB floppy disk drive, all the normal ports hidden on the rear, and DOS 5.0. A near 9-inch monochrome Toshiba display runs off a Paradise/Western Digital WD90C21 video chip set with 256K of video RAM.

Our test results reinforced our initial positive impression. Powered by a 25-MHz 386SL processor with 70-ns memory

FACT FILE

Toshiba T4400SX

List price (tested configuration): With LCD, $5,299; with gas-plasma display, $5,599.

Tested Configuration: 2MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, $435; 4MB RAM upgrade, $699; 6MB RAM upgrade, $999; upgrade to 120MB hard disk, $500; external floppy disk drive, $399; external keyboard, $159; numeric keypad, $79; expansion chassis, $999; extra battery, $345; battery charger, $289; extra AC power adapter, $185; car battery adapter, $199; 2,400-bps external modem, $199; 2,400-bps (MNP 5, V.42bis) modem, $259; standard carrying case, $79; executive portfolio, $105; leather carrying case, $239.

Toshiba T3300SL

List price (tested configuration): $3,999.

Tested Configuration: 2MB RAM, 80MB JVC hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: same as Toshiba T4400SX.

Toshiba T2200SX

List price (tested configuration): $3,499.

Tested Configuration: 2MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, $479; 4MB RAM upgrade, $889; 8MB RAM upgrade, $1,779; OS/2 2.0, $265; external floppy disk drive, $399; numeric keypad, $79; expansion chassis, $969; extra battery, $185; battery charger/AC power adapter, $189; 2,400-bps (MNP 5, V.42bis) modem, $259; fabric carrying case, $79; executive portfolio, $105; leather carrying case, $239.

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-587-6034

540 ON READER SERVICE CARD

Toshiba T4400SX (LCD), Toshiba T3300SL, Toshiba T2200SX

backed by a 25-ns SRAM four-way set-associative write-through cache, the Toshiba T3300SL scored above-average processor and memory marks. The JVC 2085 IDE hard disk was competitive, while the video chip set finished near the front ranks. Its battery life was 3 hours 37 minutes on our Battery Rundown test and 3 hours 40 minutes with power-saving features enabled.

The Toshiba T2200SX registered average performance on all our benchmark tests save the video test, where its Western Digital chip set combined with the fast video RAM to give well above-average performance on both tests. Its battery life was strong: 3 hours 22 minutes on our Battery Rundown test and 4 hours 6 minutes with power saving enabled.

The feel of these PCs is also superior. The unit's 82-key keyboard contains comfortable-size keys with nearly full key travel. The plastic-and-metal chassis proved very solid, and the screen was firmly hinged. And at 1 by 5.5 by 3 inches and 0.8 pounds, the power-supply brick is only slightly larger than a package of cigarettes.

Options for all Toshiba notebooks include fabric or leather carrying cases, data and/or fax modems, coprocessors, and the DeskStation IV docking station.

Toshiba warranties all its notebooks for one year on parts and labor; it offers toll-free technical support and maintains a BBS. Authorized service centers handle repairs.—*OR*

Transource Computers

Transource Verxion 386SX/20

The Transource Verxion 386SX/20 is an absolutely average notebook computer except for one thing: its price. At $1,655—the lowest priced unit tested here—it strikes an excellent balance between performance and economy.

Based on a 20-MHz Intel 386SX, the Transource measures 2 by 12 by 8 inches and weighs 6.8 pounds with its nickel cadmium battery. That weight, however, includes an internal power supply: There is no separate AC adapter to carry around, only a standard power cord. Our dark-gray test unit came with 4MB of 70-nanosecond RAM (the maximum), a 19-millisecond 60MB Conner CP-2064 hard disk with a 32K buffer (80MB and 100MB capacities are available), and a 1.44MB floppy disk drive. The 10-inch Hitachi 640-by-480 VGA screen, powered by a Cirrus Logic GD610/620 chip set with 384K of 80-ns video RAM, displays 16 shades of gray.

Transource Verxion 386SX/20

SUITABILITY TO TASK

Transource Verxion 386SX/20

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	○	○	○
Desktop replacement	●	●	○	○

The video subsystem can drive a 72-Hz noninterlaced external monitor at resolutions up to 800-by-600 with 16 colors.

Performance in every category was average—slightly lower than the mean on memory and slightly higher on video, but always near the middle. The Transource's battery life on our Battery Rundown test was 2 hours 34 minutes; under test conditions simulating normal use, the battery life was 3 hours 12 minutes. A utilities subdirectory provides power management through a set of programs that can be called from the AUTOEXEC.BAT file, allowing the user to set, among other things, hard disk and display shutdown times.

Transource Computers has built a good, solid machine. The keyboard is snappy and responsive. Cursor keys form an inverted T; Home, End, PgUp, and PgDn keys are lined vertically on the side. On the list of small favors is the Transource's 1.44MB floppy disk drive, mounted on the right side at the rear of the machine so that a side-mounted mouse, like Logitech's TrackMan Portable, won't get in the way of the drive. Another is the AMI BIOS, which can be upgraded by replacing a single chip. ARCNet or Ethernet connections are available for an extra $150 each. An external fax modem is available as well, but with no internal modem support, those looking to stay in touch with the home office should look elsewhere.

The Verxion 386SX/20 comes with a 12-month warranty covering parts and labor; on-site service is available from Intel. Technical support is toll-free.—*AK*

FACT FILE

Transource Verxion 386SX/20

Transource Computers, 2033 W. North Ln., #18, Phoenix, AZ 85021; 602-997-8101; fax, 602-997-8886

List price (tested configuration): $1,655
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1 44MB floppy disk drive, DOS 5 0, Microsoft Windows 3.1, carrying case
Options: 1MB RAM upgrade, $45, with 80MB hard disk, $1,755, with 100MB hard disk, $1,855, Ethernet network adapter, $150, ARCnet network adapter, $150

550 ON READER SERVICE CARD

INTRODUCING AFFORDABLE COMPUTERS FROM THE COMPANY THAT'S ALWAYS STOOD FOR MORE THAN AFFORDABILITY.

THE COMPAQ DESKPRO/i. SO A LIMITED PRICE LEADS

The company most qualified to advance the state of the desktop computer announces four systems that represent a breakthrough in R&D. At prices that won't ruin your P&L. Reflecting the level of thinking and quality that you've come to expect from Compaq.

At Compaq, there's a fundamental belief held by all of us that when you set extraordinary goals, extraordinary people will meet them.

Recently, for example, you made it clear to us that you wanted new PCs, with everything from advanced graphics to audio capability to affordable prices. Our response: the COMPAQ DESKPRO/i Family of PCs. Four new systems loaded with features to enhance productivity.

The built-in COMPAQ QVision 1024 Graphics Controller, for example, allows you to scroll, resize windows and pull down menus up to ten times faster than most popular video graphic subsystems. So quickly, as a matter of fact, you may find your computer waiting for you. Instead of the other way around.

Its unique processor upgrade path ensures that your PC won't be swept into obsolescence.

Simple chip upgradability and a 64-KB cache

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MUCH FOR THE IDEA THAT TO LIMITED THINKING.

memory module option provide quantum leaps in performance. Without

Intel 386/25, 386/33, 486SX/25, 486/33 ◆ *QVision accelerated graphics* ◆ *Chip upgradability* ◆ *Integrated business audio* ◆ *4 MB RAM (expandable to 32 MB)* ◆ *Cache memory standard* ◆ *3 ISA expansion slots* ◆ *3 drive bays* ◆ *84-MB to 510-MB hard drive options* ◆ *Multi-level security features* ◆ *Microsoft MS-DOS 5.0 as published by Compaq*

similar outlays of cash.

The fully integrated audio system brings an unprecedented, yet not unfamiliar dimension to mainstream business computing: your voice. The result of a collaboration between Compaq and Microsoft, it allows you, among other things, to actually paste voice messages into spreadsheets and documents. Either as notes to yourself or as voice-mail across your entire network.

And we've engineered this breadth of technology right onto the PC's system board, preserving the small footprint, large storage capacity and expansion of the COMPAQ DESKPRO/i.

Not to mention your financial integrity.

Add CompaqCare, a new service and support program with our free one-year, on-site* limited warranty. An Asset Management Provision (that gives you and your network administrator a snapshot of your PC's configuration). And you have nothing short of a system that breaks a lot of new ground. Without breaking the bank.

For more detailed information, just call us at 1-800-345-1518, ext. 210 in the U.S., or call us at 1-800-263-5868, ext. 210 in Canada.

We bet you'll be as excited about the COMPAQ DESKPRO/i as we are.

In scrolling, window resizing and accessing menus, our new QVision accelerated graphics beat the competition by as much as 10 to 1.

You can paste voice messages into Microsoft Windows 3.1 business documents and spreadsheets with our integrated business audio system.

COMPAQ

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OUR NEW NOTEBO MILLION BUCKS. WHICH C MISLEADING

Recently, our engineers set out to create a remarkably different notebook computer. With all of the quality, durability and features that you need. All at a sensible price. The result, as you can plainly see, is a remarkably different notebook. The new COMPAQ Contura PC.

One of the best things to happen to notebook computing since the fold-down airline tray table, the COMPAQ Contura Family of notebook PCs sets the standard for what an affordable notebook ought to be.

Just beneath its sleek, ergonomic styling lies the rugged, well-tested, well-thought-out PC you expect from Compaq.

No substandard parts

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OK PC LOOKS LIKE A OULD MAKE THIS THE MOST AD IN HISTORY.

or components. No second-rate manufacturing. No logos stuck on the outside after somebody else's guts went inside.

Thanks to high levels of chip integration and some of the smartest mechanical design this side of NASA, we've managed to engineer costs out and the right stuff in.

Intel 386SL/25 with 64-KB cache ◆ 4 MB RAM (up to 12 MB) ◆ 60- or 120-MB hard drive
Intel 386SL/20 ◆ 2 MB RAM (up to 10 MB) ◆ 40- or 84-MB hard drive ◆ Both models: 6.2 lbs. ◆ 9.5" VGA display ◆ Isolated inverted "T" cursor controls ◆ 3.5-hr. NiCd battery (optional NiMH battery) ◆ Microsoft MS-DOS 5.0 as published by Compaq

Open either COMPAQ Contura PC and you'll find a large, 9.5-inch screen beaming brightly.

Lay your fingers on the keyboard and they immediately feel at home.

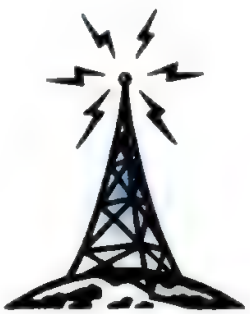
This notebook also has a unique ability to hibernate when left idle, saving all open files to the hard drive and automatically shutting your notebook down. Preserving your remaining battery life. Start up hours, days, or even years later, and you're right where you left off.

In addition to all of the above, the COMPAQ Contura notebook PCs support three internal power-conserving modems from Compaq.

All of which is backed by CompaqCare, our new service and support program, which includes a free one-year limited warranty good anywhere in the world. And free on-site* service anywhere in the U.S. and Canada.

For information, call 1-800-345-1518, ext. 220 in the U.S., or call 1-800-263-5868, ext. 220 in Canada.

We'll tell you more about it. We'll tell you all the places you can get it. And we'll tell you that you won't find an affordable notebook PC that looks this good and works this well no matter who you call.



Just because you're out of the office doesn't mean you're out of touch. The COMPAQ Contura PC features an optional power-conserving 2400-bps data/9600-bps fax modem.

As well as a uniquely sophisticated power conservation tool, Hibernation also serves as an easy-to-use placemark.

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AN INEXPENSIVE PC THA FROM THE COMPANY T

What happens when the best computer engineers in the world design a low-priced desktop PC? You get the new COMPAQ ProLinea Line of PCs, perhaps the best value PCs in the world. What happens when a clone maker designs a low-priced PC? You get what you pay for.

When Compaq engineers set out to build an affordable, full performance desktop PC with all the essential features, there were a lot of options to choose from.

We could have bought an existing low-end computer company.

We could have farmed out all manufacturing.

We could have bought parts from the cheapest vendor in town.

But then all we would have ended up with is simply another inferior,

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T'S AS GOOD AS A COMPAQ. HAT OUGHT TO KNOW.

low-priced clone. And what we wanted was a low-priced COMPAQ computer.

Which is what you told us you wanted.

So through some high levels of chip integration and some equally high levels of engineering, design and just plain common sense, we've cut costs in system design and manufacturing.

While still managing to deliver 100 percent of the virtues you've come to expect from Compaq.

You can choose from three different models, opting for either Intel 386SX/25 or 486/33 processing power.

So whether it's expansion, storage, processing speed or a small footprint that you're most concerned with, there's a model perfectly suited to your needs.

And each comes with a high-resolution 1024 x 768 video system.

Most importantly, the new COMPAQ ProLinea PCs are backed not only by the assurance of the COMPAQ name, but also by CompaqCare, our new service and support program. Which includes a free one-year, on-site* limited warranty, and a host of other services.

And to go along with our new line of PCs, there's a whole new line of places you can find them. Give us a call for more details.

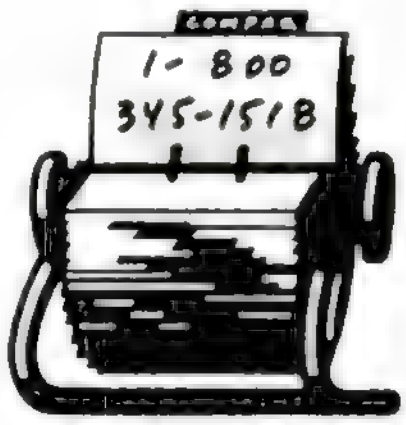
In the U.S., call us at 1-800-345-1518, ext. 215, and in Canada, just call 1-800-263-5868, ext. 215.

We think you'll be pleasantly surprised at exactly how much the COMPAQ ProLinea PCs have to offer.

And equally surprised by how little we're able to offer them for.

Intel 386SX/25 ◆ *small footprint* ◆ *2 MB RAM* ◆ *2 ISA slots* ◆ *2 drive bays* ◆ *40- or 84-MB hard drive*
Intel 386SX/25 ◆ *2 MB RAM* ◆ *3 ISA slots* ◆ *3 drive bays* ◆ *84- or 120-MB hard drive*
Intel 486/33 ◆ *4 MB RAM* ◆ *3 ISA slots* ◆ *3 drive bays* ◆ *84- or 120-MB hard drive*
All models include high-resolution 1024 x 768 video and pre-installed Microsoft MS-DOS 5.0 as published by Compaq

All in all, the COMPAQ ProLinea 3/25zs PC sizes up quite nicely. At a mere 12.6" x 14.9" x 3.5", it's one of the smallest footprints in the industry.



All of our models are backed by CompaqCare, our comprehensive new service and support program. For details, just call 1-800-345-1518.

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AFFORDABILITY RUNS DEEP.

Affordable prices aren't limited to our new products. In fact, we've lowered suggested list prices by up to 40% on COMPAQ hardware. And even more on our list of options.

In the past twelve months at Compaq, we've incorporated major efficiencies in design, engineering and manufacturing across our product line.

As a result, you'll notice savings on everything from our notebook PCs to our desktop computers to our servers to our extensive list of optional equipment. The right computer at the right price.

The following list includes just some of the COMPAQ products that are now more affordable. Obviously, when it comes to the subject of affordability, we could go on and on. But we'd rather talk to you directly.

Give us a call and we'll tell you where you can find new COMPAQ products, not-so-new COMPAQ products and the new prices for both.

Call 1-800-345-1518, ext. 225 in the U.S., or in Canada, call 1-800-263-5868, ext. 225.

DESKPRO 386s/20N Model 0 ◆ DESKPRO 386s/20N Model 1 ◆ DESKPRO 386s/20N Model 60 ◆ DESKPRO 386s/20 Model 1 ◆ DESKPRO 386s/20 Model 60 ◆ DESKPRO 386s/20 Model 120 ◆ DESKPRO 386/25M Model 1 ◆ DESKPRO 386/25M Model 60 ◆ DESKPRO 386/25M Model 120 ◆ DESKPRO 486s/16M Model 1 ◆ DESKPRO 486s/16M Model 60 ◆ DESKPRO 486s/16M Model 120 ◆ DESKPRO 486s/25M Model 1 ◆ DESKPRO 486s/25M Model 60 ◆ DESKPRO 486s/25M Model 120 ◆ DESKPRO 486/33M Model 1 ◆ DESKPRO 486/33M Model 120 ◆ DESKPRO 486/33M Model 340 ◆ DESKPRO 50M Model 1 ◆ DESKPRO 50M Model 120 ◆ DESKPRO 50M Model 340

PORTABLE 486c Model 120 ◆ PORTABLE 486c Model 210 SLT 386s/20 Model 60 ◆ SLT 386s/20 Model 120 ◆ LTE Lite/20 Model 40 ◆ LTE Lite/20 Model 60 ◆ LTE Lite/20 Model 84 ◆ LTE Lite/25 Model 60 ◆ LTE Lite/25 Model 84 ◆ LTE Lite/25 Model 120 ◆ LTE 386s/20 Model 30 ◆ LTE 386s/20 Model 60 ◆ LTE 386s/20 Model 84

SYSTEMPRO/LT Model 486SX/25-210 ◆ SYSTEMPRO/LT Model 486SX/25 510◆ SYSTEMPRO/LT Model 486SX/25-680 ◆ SYSTEMPRO/LT Model 486/33-210◆ SYSTEMPRO/LT Model 486/33-510 ◆ SYSTEMPRO/LT Model 486/33-1020 ◆ SYSTEMPRO 486/33-420 ◆ SYSTEMPRO 486/33-840 ◆ SYSTEMPRO 486/33-2040

40-Megabyte Hard Drive ◆ 60-Megabyte Hard Drive ◆ 84-Megabyte Hard Drive ◆ 120-Megabyte Hard Drive ◆ 210-Megabyte Hard Drive ◆ 340-Megabyte Hard Drive ◆ 510- Megabyte Hard Drive ◆ 240-Megabyte Drive Array Pair ◆ 420-Megabyte Drive Array Pair ◆ 680-Megabyte Drive Array Pair ◆ 1.02-GB Drive Array Pair ◆ 1-Megabyte Memory Module ◆ 2-Megabyte Memory Module ◆ 4-Megabyte Memory Module ◆ 8-Megabyte Memory Module ◆ 2-Megabyte Single-Socket Memory Module ◆ 8-Megabyte Single-Socket Memory Module ◆ 32-Megabyte Dual-Socket Memory Module ◆ 1.3-GB Differential Interface Hard Drive....

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CIRCLE 137 ON READER SERVICE CARD

LAPTOPS A-GO-GO

Color Hits the Road

Whether you need a 486 power portable with plenty of muscle and expansion room, or a slender notebook to slip inside your briefcase, *PC Magazine* reviews 14 of the brightest stars in the portable market.

by Christopher Barr

A notebook with a color display is comparable to a desktop PC—not yet equal but close. Although it's heavenly having color, portability, and battery operation in a single package, color portables cannot display as many pixels on-screen as a standard Super VGA monitor. Even worse, the slow screen refresh rates and response times of today's lower-priced passive-matrix color notebooks make Windows difficult to use. If you move up the food chain, you'll find that the higher-quality (and higher-priced) active-matrix color notebooks are stunning to behold but disappointing when it comes to battery life. Color luggables leapfrog average desktops in features and performance, but they starve if their umbilical cords aren't attached to an AC outlet. And if carrying

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one doesn't break your back, it just may break your bank, with prices exceeding $16,000.

Still, you should find a color portable that will please your eyes, as well as your wallet, among these 14 systems from AST, Compaq, Dell, Dolch, IBM, NEC, and Toshiba. They come in all sizes and weights, but the market splits clearly into two major categories: color notebooks weighing 8 pounds or less, and heavier, do-anything luggables with processing power and room for expansion; there are few products in between. The screen technology falls into two camps as well: active-matrix, which gives you stunning color, versus passive-matrix, which compromises looks and performance for affordability. In this roundup, we look at four battery-powered notebooks, the IBM PS/2 Model CL57SX—which is neither fish nor fowl, and nine AC powered color luggables.

The AST Premium Exec 386SX/25C and Dell System 325NC, the only passive-matrix notebooks in our roundup, begin around $3,300. Considerably more expensive are the $5,999 386-based NEC UltraLite SL/25C and the $7,699 486-based Toshiba T4400SXC, both featuring active-matrix displays.

Too big to be considered notebooks are the active-matrix clamshells. The $6,410 IBM PS/2 Model CL57SX, which is 386SX-based and weighs 12 pounds, is the only clamshell that operates on batteries (although its battery life is a measly 1 hour). The $8,099 NEC ProSpeed 486SX/C (16.8 pounds) and the $9,948 Toshiba T6400SXC (13 pounds) require an AC tether to drive their 486SX processors. In the lunch-pail form factor with expansion slots to spare are the EISA-based Compaq Portable 486C (17.5 pounds), which goes for $9,017, and three Dolch models: the $12,511 Dolch P.A.C. 386-33C, $15,442 Dolch P.A.C. 486-33E, and $16,937 Dolch P.A.C. 486-50E screamer. Dolch and NEC even go so far as to offer multimedia versions with CD-ROM drives.

Also included in this color roundup are two square pegs—Micronics's Mport 450/Color Mpression and the NEC ProSpeed 486SX. The latter is the monochrome active-matrix twin of the NEC ProSpeed 486SX/C, while the Mport 450's unique self-contained portable presentation system features a monochrome clamshell portable driven by Intel's new 50-MHz DX2 speed-doubled CPU bundled with an active-matrix color-display panel for overhead projectors.

LOW COLOR, LOW COST

You will pay a premium for any color portable over what you will pay for monochrome because it costs extra to make color. Passive-matrix panels, manufactured in Japan by Sharp and Sanyo, aren't too different from ordinary monochrome screens, but they use layers of color filters sandwiched between the glass.

Compared with active-matrix panels, passive-matrix units come up short in three ways. First, they can't display as many colors. The actual LCD panel can show only 16 simultaneous colors, independent of resolution, despite the fact that the video controller might boast a palette of 256,000 colors. Most of the active-matrix models we reviewed surpassed standard VGA's 16 simultaneous colors. Particularly impressive were the Toshiba, Dolch, and NEC ProSpeed models, all of which display 256 colors at 640-by-480.

The second drawback to passive-matrix color technology is its speed (or lack thereof). Its response time (the time it takes to turn a pixel on and off) is too slow for real-time video and therefore can't run full-motion video. Another negative byproduct of a slow response time is "crosstalk," a ghost image at the corners of dialog boxes; this is quite noticeable under Windows. Windows users take another hit: The mouse cursor disappears. To paraphrase vendors, a screen with good "mouse speed" is one where the cursor doesn't disappear with quick mouse movements.

Third, passive-matrix panels aren't as bright and have a lower contrast than active-matrix panels. A typical passive-matrix screen has a light-to-dark contrast of

HIGHLIGHTS

Color Portables

COLOR PORTABLES tend toward one of two groups: battery-powered notebook or laptop systems weighing less than 8 pounds, and AC-only luggables weighing 15 to 20 pounds, with room for two or more internal expansion slots.

BATTERY NOTEBOOK systems included the AST Premium Exec 386/25C, Dell System 325NC, NEC UltraLite SL/25C, and Toshiba T4400SXC. The Editors' Choice Toshiba T4400SXC had the best performance, best display, longest battery life—and highest price.

ACTIVE-MATRIX displays provide superior color quality and freedom from ghosting, at a $1,500 to $2,000 premium over a comparable monochrome system. All the luggable systems use active-matrix color, as do the NEC UltraLite SL/25C and Toshiba T4400SXC.

PASSIVE-MATRIX displays provide significantly lower-quality color, but as the price premium over a comparable monochrome system falls from $1,000 to less than $500, they may become more interesting to buyers. Compared to monochrome systems, they'll be slightly bulkier (because of the thicker color displays) and have shorter battery life—a small price to pay for great color.

MOST POWERFUL AC-only luggables were the two bulky 21-pound Dolch P.A.C. 486's and the Editors' Choice 17-pound Compaq Portable 486C.

WINDOWS VIDEO performance was faster, on average, than the monochrome systems. Speed of the Compaq and the T4400SXC approached that of better desktop systems.

FOR USERS WHO want crisp, high-contrast displays but without the color price premium, NEC and Compaq offer monochrome active matrix displays, and Toshiba offers a plasma display.

15 to 1 (the display's brightest pixels are up to 15 times as bright as its darkest ones). Active-matrix panels feature contrast ratios as great as 70 to 1. Individual pixels are turned on and off a row at a time and a column at a time. On a 640-by-480 panel, 479 rows wait while one row is powered on, and 639 columns wait while one column is powered on. The waiting time means a contrast and brightness loss often visible around the display's perimeter.

Active-matrix panels have no such problems because each pixel is individually controlled by three thin film transistors (TFTs), one each for red, green, and blue, etched into the layers of the LCD panel. A 640-by-480 screen will have 921,600 TFTs etched into the screen. Since each color in a pixel is turned on and off by a single transistor, the contrast, brightness, and speed are superior to that of a passive-matrix panel.

THE BEST COLOR MONEY CAN BUY

Since the process for manufacturing active-matrix panels is akin to making an integrated circuit (IC), active-matrix panels cost a fortune and can increase a monochrome system's price by up to $3,000. (Dolch offers color active-matrix upgrades to its existing systems for $3,500 on a one-unit order.) All of the panels used in these units were made in Japan by either Sharp, NEC, Hitachi, or Display Technologies; the latter is the IBM (Japan)–Toshiba joint venture.

It doesn't look like prices will come down soon; like ICs, prices on active-matrix panels are yield-related. Only when the volume and manufacturing yields go up do prices come down. Right now, the yields on active-matrix panels are not increasing fast enough, so prices remain high. While most foundries have a target goal around 80 percent, less than 40 percent of the active-matrix screens that are made can be used; the others are simply scrapped.

In a move last year by the U.S. government to protect U.S. active-matrix panel makers, the federal government imposed a 62.5 percent duty on imported active-matrix panels. To circumvent the duty, manufacturers could import fully assembled computers. As a result, Compaq and Toshiba promptly moved their assembly to offshore locations, and all the

PC MAGAZINE

EDITORS' CHOICE

- **Compaq Portable 486C**
- **Toshiba T4400SXC**

This year's color portables fall into two groups: battery-powered notebooks weighing under 8 pounds, and more substantial lunchboxes that can hold as much memory as your network file server, come with a 200MB hard disk, and contain a couple of full-length expansion cards. Since both types clearly serve users with different needs, we've chosen a winner from both groups: the Toshiba T4400SXC for the notebooks and the Compaq Portable 486C for the power portables.

LIGHT YEARS AHEAD

The Toshiba T4400SXC is the only color notebook to date driven by a 486 processor—a 25-MHz 486SX. If you need full throttle power and great color, this is your choice. While its high price ($7,699 with 4MB of RAM and an 85MB Conner hard disk) and a 9.5-pound road weight (with its power brick and cables) will stretch some wallets and briefcases, the T4400SXC is the performance leader. Its 120MB hard disk, breathtaking 9.5-inch (diagonal) active-matrix screen, 9,600-bps data/fax modem, battery life of 2 hours 26 minutes, and dominating benchmark performance—particularly under Microsoft Windows—make the T4400SXC the clear winner.

Honorable mention goes to the Dell System 325NC ($4,047 with a fast, 80MB Quantum hard disk). While passive-matrix color pales in comparison with active-matrix color, we feel its less vibrant color is better than none—almost. Our hesitation will end when the $1,000 price premium over a comparable monochrome notebook drops down to about $300, or roughly 10 to 15 percent more than a monochrome system. We believe that the System 325NC presents the best package for buyers looking to pay less for portable color. The AST Premium Exec 386SX/25C is cheaper, but the System 325NC has a newer design, better battery performance, and a 9,600-bps data/fax modem. One drawback: The Dell notebook has an undersized keyboard to achieve its smaller dimensions. The Premium Exec 386SX/25C's screen quality is comparable with that of the System 325NC; you would not be dissatisfied with AST's notebook.

DESKTOP REPLACEMENT

Delivering the best bang for the buck among AC-only luggables was the $9,017 Compaq Portable 486C. While our system came with a 120MB Conner hard disk, the Portable 486C can house a 210MB hard disk, along with 32MB of RAM and two 32-bit EISA slots. Its 33-MHz 486 chip's performance was enhanced by a bright 10.5-inch Sharp active-matrix color panel and Compaq's own video chip set, which set the standard among all the portables covered in this issue. As the only system to obtain a Graphics Winmark score of 3 million, the Portable 486C offers desktop graphics performance under Windows. Compaq delivers file-server power in a 17-pound package that seems lighter than it is, due to a thoughtful design. It could be the only system you'll need.

For those who crave power and expandability at any cost, Dolch has the goods. The Dolch P.A.C. 486-50E offers the greatest processing power and expandability (three of the six EISA slots are open) for those whose special needs can overcome a $16,937 price tag. Dolch even offers a multimedia version, complete with a CD-ROM drive and a sound board. The P.A.C. 486-50E's 21-pound weight and high price relegate this performance monster to niche markets, though.

active-matrix machines reviewed here were assembled overseas. Still, you will pay more for all the extra travel.

PERFORMANCE

The nine AC-powered systems in this roundup proved to be among the fastest of any systems PC Magazine Labs has ever tested. Since active-matrix technology adds a substantial price premium, manufacturers tend to combine color with the fastest available CPUs and fast, large-capacity hard disks. The Dolch's 486-50E, with its Quantum 16-ms SCSI hard disk, and Micronics' Mport 450/Color Mpression, with its 50-MHz DX2 processor and 14-ms Quantum IDE hard disk, were the leaders on processor and disk performance. The Compaq Portable 486C led the way in video performance. Among the battery-powered notebooks, the 386SL/25 passive-matrix Dell System 325N squeezed more than 5 hours from its battery. More impressively, the power-hungry, active-matrix Toshiba T4400SXC managed more than 4 hours.

REVIEW CRITERIA

To be included in this review, vendors had to provide PC Labs with a production-quality color system by April 24, our testing deadline. Several more color notebooks will be in the stores this summer, including the Leading Edge N3/SL25 and the ALR Ranger M486—both passive-matrix offerings. New active-matrix systems include the Sharp 6881 and the Zenith Z-Note 325Lc (two notebooks) and the Dolch M.A.C.H.—a rugged, expandable 486 luggable. Compaq rounds out the pack with a monochrome active-matrix version of its color 486/33 EISA luggable system and a new, 6.5-pound addition to the LTE/Lite family, the color active-matrix Compaq LTE/Lite 25c. (See the First Looks section for reviews of some of these later arrivals.)

Buying a color notebook is a lot like buying a car: We would all love to drive BMWs and Ferraris, but we usually settle for less. Monochrome notebooks will anchor the bulk of the portable market for the next few years simply because of their price/performance ratio when compared with color machines, although affordable color is here. We believe active-matrix technology is the way to go for bright, well-contrasted colors. For notebooks, passive-matrix color is a far better alternative to monochrome—if the price is right. When passive-matrix color adds no more than ten or fifteen percent to the entire system cost (for example, color adds three or four hundred dollars to the price of a $3,000 system), the appeal of monochrome notebooks is gone.

Suitability to Task: Color Portable Computers

No one color portable system did everything well, and none proved to be excellent for running Windows. Notebooks are good road warriors, but a notebook often lacks the power to serve as your only system. Powerful luggables are excellent desktop replacements but poor road warriors.

Road warrior/communications measures how complete a traveling companion your system is. Important factors include a light travel weight, a long battery life, and good communications options. The ratings for the necessary features range from *excellent* (a travel weight no more than 9 pounds, an excellent screen measuring at least 9 inches diagonally, exceptional power-conservation features combined with a good battery life, a 9,600-bps internal modem with 9,600-bps fax capability, and an 80MB hard disk) down to *poor* (a weight ranging from 10 to 25 pounds, a 2,400-bps modem, and a 40MB hard disk). All AC-powered transportables suffered in this category and are therefore poor road warriors.

DOS applications describes each system's ability to run DOS software competently. An excellent system has at least a 33-MHz 386 processor. It must have an 80MB hard disk available; disk, memory, and video performance in the top 25 percent on PC Magazine Labs' Hardware Performance Tests, Release 6.0; and an excellent display measuring at least 9 inches diagonally. Systems rated as *good* feature a 60MB hard disk option, benchmark test performance in the top half of the color category, and a display with at least an 8.5-inch measurement diagonally.

SUITABILITY TO TASK

Product Name

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	◐	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Windows applications are among the most demanding on any system, so we made this category particularly challenging. To be considered excellent for this task, each system had to have memory expandable to at least 8MB; a 120MB hard disk available; Windows graphics performance in the top 25 percent, based on Graphics Winmark test score; a display measuring at least 9 inches diagonally; a built-in pointing device; and for battery-powered portables, power management that works under Windows. None of the systems met these requirements. Good systems included an 80MB hard disk, performance in the top half of the color systems reviewed, good displays, and a serial and a mouse port (or two serial ports).

To be considered a suitable **desktop replacement**, each system had to support a docking station or provide suitable internal expansion, have at least 386/33 performance, offer large hard disks, and support Super VGA on an external monitor. We also took the keyboard layout (or external keyboard support) into consideration.

AST Research Inc.

AST Premium Exec 386SX/25C

It's not the perfect notebook, but it is a step closer. Offering passive-matrix color for $3,595, the 7.5-pound AST Premium Exec 386SX/25C is the lowest priced color notebook we tested.

The Premium Exec 386SX/25C's 8.4-inch Sanyo-manufactured passive-matrix LCD supports 16 simultaneous colors at 640-by-480 and 256 simultaneous colors at 320-by-200. Compared with the active-matrix systems in this roundup, its colors seem washed out. The colors of passive-matrix LCDs can't hold a candle to the vi-

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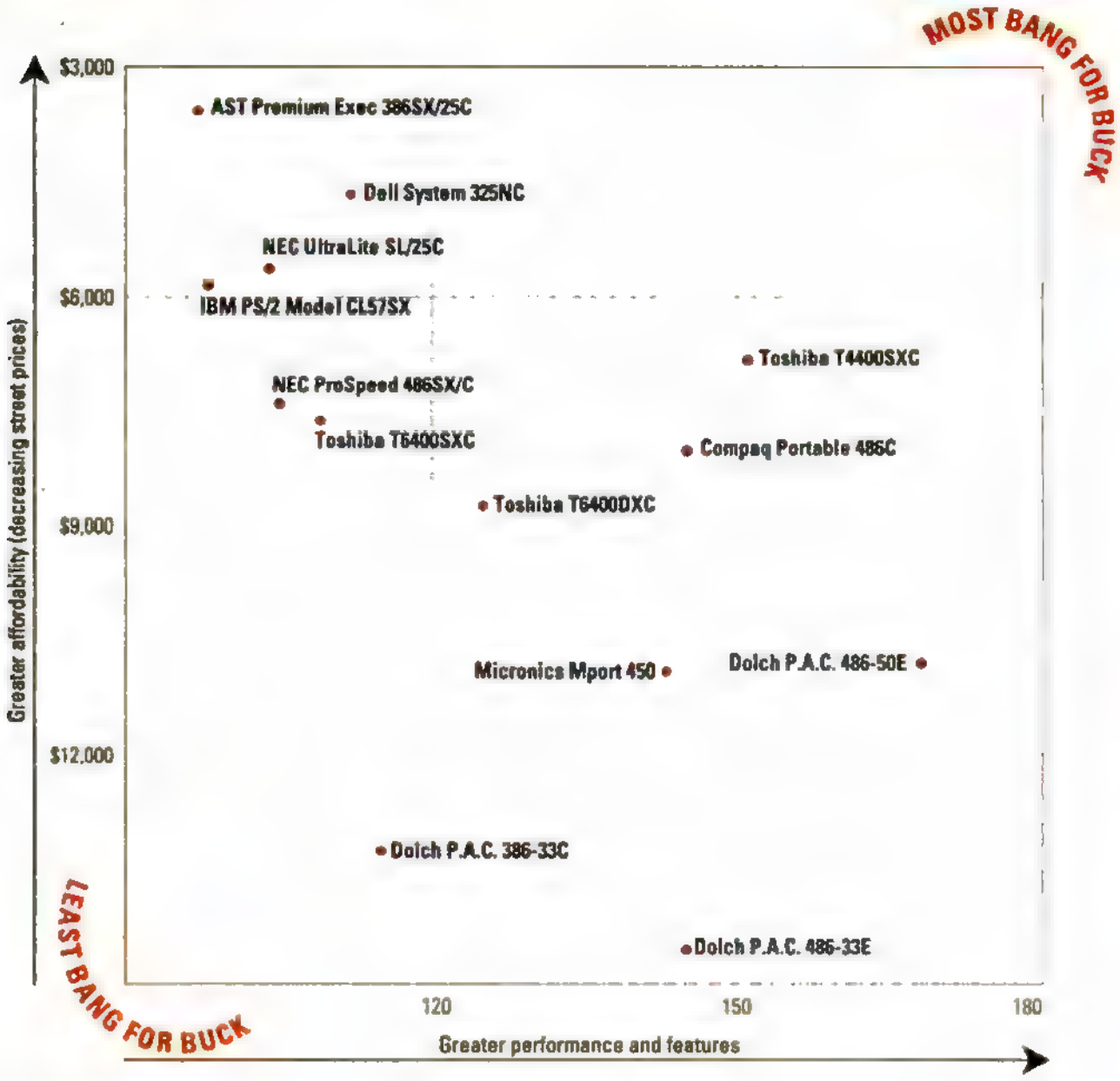
Price/Performance Index: *Color Portable PCs*

Of the 13 true color portables in this roundup, the performance and features winners were all active-matrix units: the Compaq Portable 486C, Dolch P.A.C. 486-50E, Dolch P.A.C. 486-33E, and Toshiba T4400SXC, with their scores ranging from 145 to 168 points. The passive-matrix AST Premium Exec 386SX/25C certainly dangled the smallest price tag, but its older design and smaller feature set don't compare with the assets of the pricier competition.

While the Dolch systems' excellent components allowed for excellent benchmark test scores (except for video performance), their high-end cost affected their price-versus-performance scores. The Portable 486C's well-thought-out design and much lower price tag certainly put it in the luggable lead. The T4400SXC, a 486SX/25, outdid the competition in terms of the composite picture: performance, features, quality, and price. This is the notebook to beat.

The chart below rates the 13 color portables on more than 20 features and performance items and compares them to each computer's selling price. The x-axis measures increasing performance. The y-axis measures increasing affordability (lower price).



THE DATA POINTS

The following elements make up the performance/features score: benchmark test results (49 percent); travel weight, size, and battery life (9 percent); memory and disk space (23 percent); screen size, modem, Super VGA output, extra cursor keys, I/O ports, power-conservation features, free software, an extended warranty, and on-site service availability (19 percent).

The selling price, charted on the *y*-axis, includes the system price and the price of the most useful modem. We discounted laptops available through dealers by 15 percent to approximate street prices. We did not discount mail-order systems.

To view the data we used to create this chart, look for 14BANG.WK1 in the Software Library of PC MagNet's Editorial Forum.

SUITABILITY TO TASK

AST Premium Exec 386SX/25C

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

brant, sharp colors of active-matrix color LCDs, which energize each pixel rather than each row or column. The Premium Exec 386SX/25C's colors look brighter when you consider that this color notebook costs less than some comparable monochrome systems reviewed.

The Premium Exec 386SX/25C uses the same highly integrated, energy-efficient Am386SXL processor as its monochrome twin, the AST Premium Exec 386SX/25. Despite average scores on most of our benchmark tests, it outperformed the monochrome model on the memory, video, and Graphics Winmark tests. The Cirrus Logic video chip set, working with 70-nanosecond video RAM, tested better than average. The Premium Exec386SX/25C lasted 2.5 hours on its nickel cadmium batteries, while its main competitor, the $3,850 Dell System 325NC (the only other passive-matrix notebook in this roundup), lasted almost twice as long on a nickel hydride battery. The Premium Exec 386SX/25C's power-

FACT FILE

AST Premium Exec 386SX/25C

AST Research Inc., 16215 Alton Pkwy., P.O. Box 19658, Irvine, CA 92713; 800-876-4278, 714-727-4141; fax, 714-727-8570

List price (tested configuration): $3,595.

Tested Configuration: 4MB RAM, 80MB JVC hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, carrying case.

Options: 1MB RAM upgrade, $249; 4MB RAM upgrade, $999; 120MB Quantum hard disk kit, $1,249; numeric keypad, $119; extra battery, $99; enhanced battery, $119; battery charger, $119; trickle charger, $29; car battery adapter, $129; second serial adapter, $99; 2,400-bps modem, $249; 9,600-bps fax modem, $499; 9,600-bps send-fax modem, $349; nylon carrying case, $99; leather carrying case, $299.

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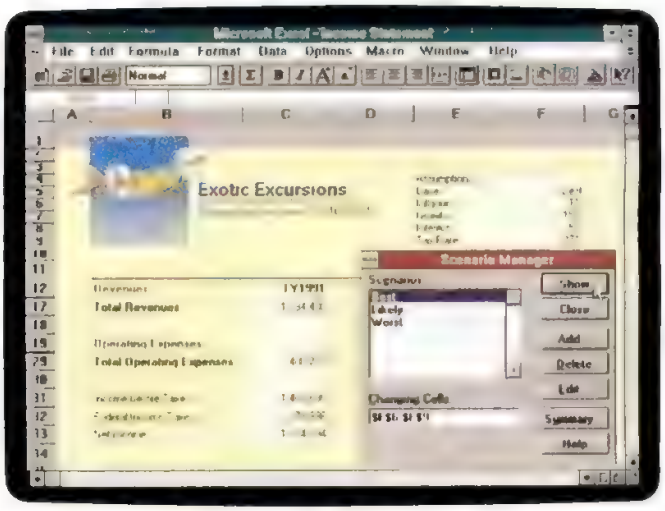

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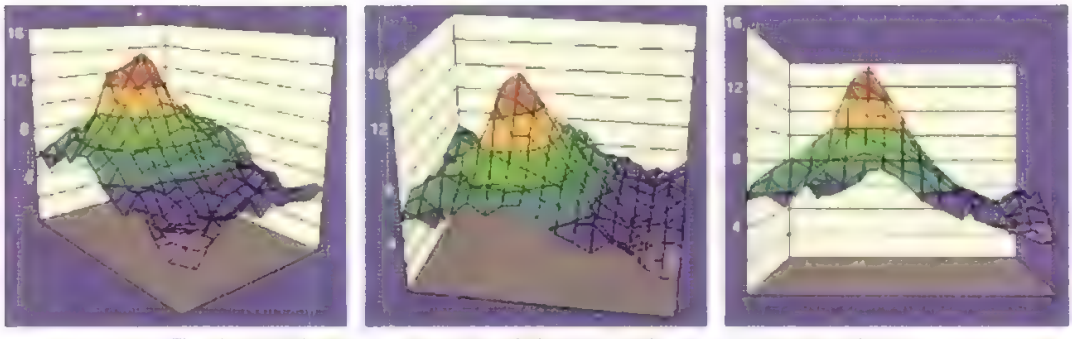

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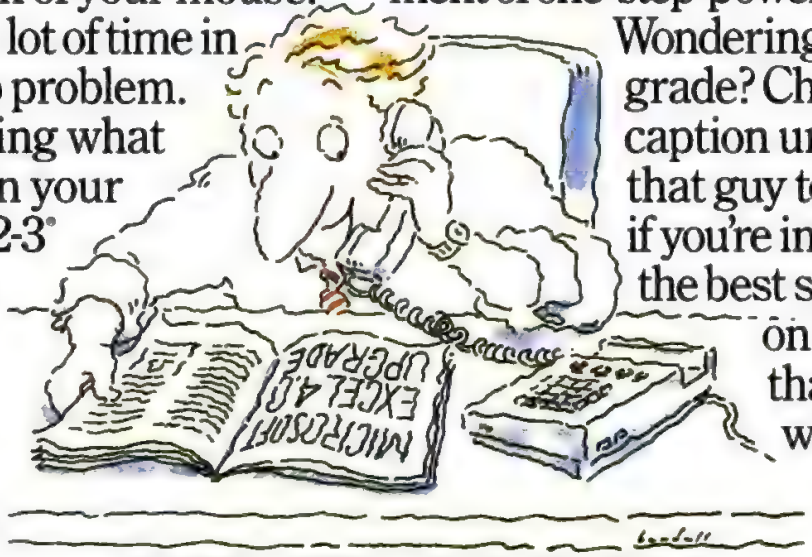

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CIRCLE 363 ON READER SERVICE CARD

What the Numbers Mean: *Color Portables*

Color displays brightened 13 of the 80 machines that PC Magazine Labs tested for this review. Of these 13, 8 featured a 486 processor. There was 1 true 50-MHz system—the Dolch P.A.C. 486-50E—and Micronics Computers' timely Mport 450/Color Mpression is the first portable we've tested that features Intel's new 50-MHz DX2 chip. The trend is clear: Faster processors combined with active-matrix color define the high end of the color portable market.

Of these eight 486-based systems, four feature EISA architecture: the Compaq Portable 486C, Dolch P.A.C. 486-50E, Dolch P.A.C. 486-33E, and NEC ProSpeed 486SX/C. We also tested the monochrome version of the ProSpeed 486SX/C, the NEC ProSpeed 486SX; its results were identical to those shown here for the color model.

The 386SX-based IBM PS/2 Model CL57SX is the lone MCA-bus system.

What we found came as no surprise. Processor test scores fell in order of processor type and speed. The P.A.C. 486-50E topped the processor performance scale, followed closely by the Mport 450. The latter's DX2/50 speed-doubler CPU performed at 87 percent of the capacity of a full-fledged 50-MHz 486DX, a score consistent with previous test results PC Labs has seen. Following the 50-MHz leaders were three 486DX 33-MHz systems, led by the Compaq Portable 486C. Dolch was the only manufacturer to use a second-level cache; the P.A.C. 486-33E's 6,154 kilobytes per second on the memory test bested the 33-MHz competition by a decent margin.

DISK

Dolch was also the only manufacturer to include a caching disk controller (4MB) to support its 486 luggables' 420MB Quantum 425S SCSI-2 hard disks—the largest-capacity units in the roundup. The P.A.C. 486-50E's 344 KBps and the P.A.C. 486-33E's 337 KBps were the best scores by far on the disk test. The Dolch P.A.C. 386-33C, an ISA-bus machine, captured the third-place spot on the disk test with its 420MB Quantum LPS425-AT hard disk (the IDE twin of the SCSI units located in the 486 Dolch notebooks), which came complete with a 256K hardware cache. The Mport 450's ISA-based 230MB Quantum ProDrive with a 256K cache, along with the Portable 486C's 120MB IDE Conner CP-30101G hard disk, closed out the top five hard disks.

The slowest hard disks belong to three battery-powered systems: the IBM PS/2 Model CL57SX, AST Premium Exec 386SX/25C, and Toshiba T4400SXC. With the wide disparity among processor types, clock speeds, and disk cache and controller types, it is difficult to draw any conclusions in terms of EISA or ISA superiority.

VIDEO

Two systems, the Premium Exec 386SX/25C and the Dell System 325NC, employ passive-matrix display technology, as opposed to the active-matrix design used by the other color systems. Active-matrix systems achieved the top eight scores on the Graphics Winmark test and the top four on the DOS-based video test, but the variety of processor types, processor speeds, and video implementations would make it incorrect to assume that these results are strictly the difference between active and passive technology. In terms of Windows performance, the Portable 486C was the fastest, with its Graphics Winmark score of 3.3 million. Toshiba swept the next three top spots with its T4400SXC, T6400DXC, and T6400SXC.

Compaq's graphical accomplishments are keyed to the company's proprietary video-subsystem designs, which consistently led the way on PC Labs' tests. The PS/2 Model CL57SX, which also relies on a proprietary design, was the fastest when it came to video but fell to midpack on the Graphics Winmark test. Toshiba uses Western Digital video chip sets—the very fast WD90C30 set for its T4400SXC and the WD90C23 for the T6400DXC and T6400SXC. All the Dolch systems, which were the slowest video performers, use the same Chips & Technologies chip set, the F82C457.

The Mport 450 stands out as a passive-matrix monochrome system with a tethered active-matrix color panel for presentations. Despite its fast 50-MHz DX2 processor, the Mport 450's Cirrus Logic chip set was a lackluster video performer, which brings into question how well the system serves its role as a portable presentation device. CONTINUES

conservation features include user-defined screen and hard disk time-outs and a deep-sleep driver that suspends Microsoft Windows when you close the case to attend to other business.

A solid yet undistinguished performer, the Premium Exec 386SX/25C sports a handsome range of options and support. If you load the 2.5- by 11.5- by 9-inch (HWD) case (which includes a standard internal front-mounted floppy disk drive) with an extra 4MB of RAM ($599) for a total of 8MB, replace the 80MB JVC hard disk with a 120MB Quantum unit, drop in a 9,600-bit-per-second fax modem, connect a simultaneous external display at 800-by-600 resolution, and add an 80387SX math coprocessor, you've got the brawn of a desktop system.

AST Research provides a one-year warranty on parts and labor, toll-free technical support, a BBS, and a help-by-fax service. The company also offers ExeCare, a 24-hour repair or replacement service that costs $45 a year to enhance your peace of mind.

AST has managed to find a workable, affordable, and colorful middle ground in the AST Premium Exec 386SX/25C. If you're looking for rock-bottom-priced color with reasonable battery performance and an array of options, read no further.—*Carol Levin*

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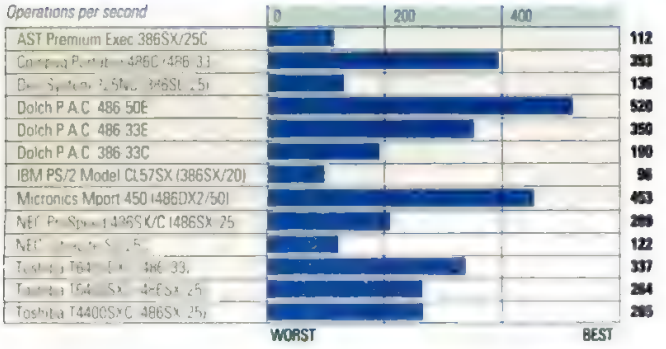
CIRCLE 177 ON READER SERVICE CARD

Benchmark Tests: Color Portables

PROCESSOR



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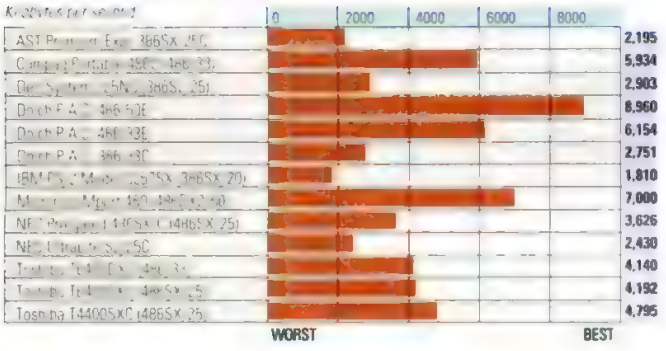
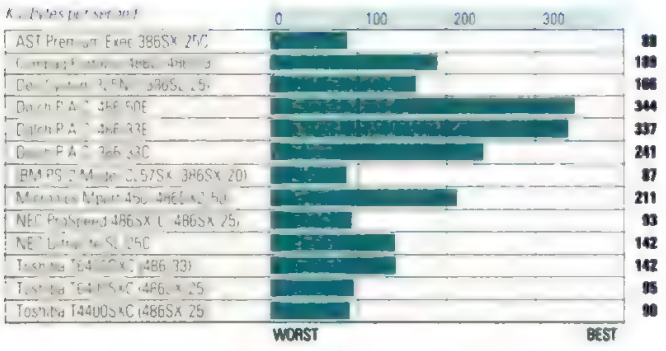
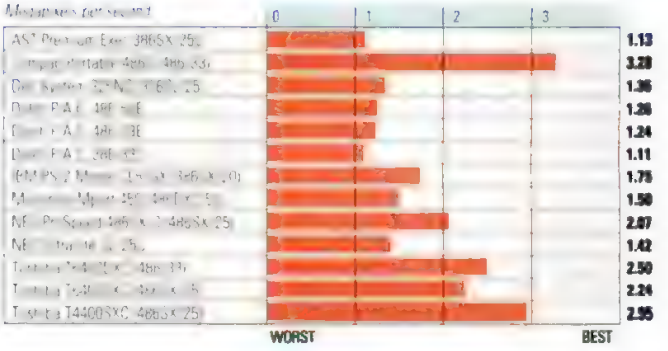


DISK



VIDEO

GRAPHICS WINMARK



Color portables with fast 486 processors and cached SCSI hard disks dominate this mixed bag of 13 notebooks.

HOW WE TESTED

We used PC Magazine Labs' Hardware Performance Tests, Release 6.0, to measure each PC's processor, memory, disk, and video subsystem performance. Each test measures the number of operations performed or the data throughput over a period of time. We also used WINBENCH 2.5 to obtain the Graphics Winmark scores. In all cases, a larger number means better performance

We performed all the tests with the RAM and video cache shadowing enabled whenever possible. We report the disk performance without software disk caches.

The **processor** test measures different aspects of the CPU's performance and its interaction with cache and main memory. The test consists of eight routines: an Instruction Mix native to the microprocessor type (386 or 486, for instance), and 128K No-Operation, Do-Nothing, Integer-Add, Integer-Multiply, Floating-Point Mix, String-Sort and -Move, and Prime-Number Sieve routines.

The **memory** benchmark test measures the read/write performance of the computer's first 640K of conventional memory.

The **disk** benchmark test evaluates the mechanical drive speed, hard disk controller functions, and bus speed, using a series of small-record (512-byte and 4K) exercises followed by similar large-record (16K and 32K) exercises. Both small- and large-record exercises include file-create, sequential write/read, and random write/read operations.

The **video** benchmark test consists of text and graphics routines. In the Direct Screen Write routine, the video adapter's screen memory writes text to the screen. The test then performs several graphics operations, including screen fills and BitBlts.

Version 2.5 of PC Labs' WINBENCH tests (our graphics performance tests for Microsoft Windows) introduces a new method of measuring graphics performance. The **Graphics Winmark** is the geometric mean of 12 WINBENCH graphics tests, measured in millions of pixels per second. PC Labs profiled the major Windows applications in November 1991 and determined which graphics functions are most frequently used within Windows. The Winmark takes into account 12 tests of these key functions and weights them to reflect how frequently the functions are used. Windows applications also use other graphics functions, but far less often.

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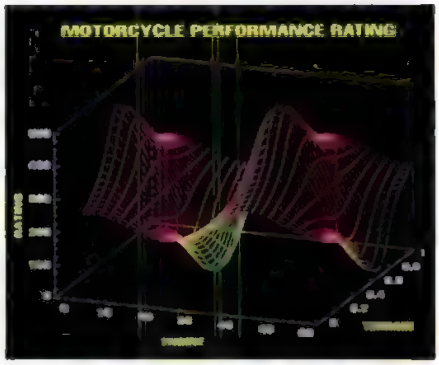

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Compaq Computer Corp.

Compaq Portable 486C

Compaq Computer Corp.'s $9,017 Compaq Portable 486C, an EISA-based active-matrix color luggable, distinguishes itself from the other 486-based portables in this review with a superior design and full 33-MHz 486DX power for the lowest price tag. Its closest competitor is the Toshiba T6400DXC, which costs about $1,100 more. The Dolch P.A.C. 486-33E, which also falls into the 486/33 category, topped the Portable 486C by $4,600 (as well as by about 2 pounds, a number of inches, and several expansion slots). But although the Portable 486C costs less than its competition, it has an extremely abundant feature set.

This AC-only system arrived with 2MB of DRAM (expandable up to 32MB), a 120MB Conner CP-30101G hard disk with a speedy 32-bit EISA controller and a 64K read-ahead buffer (you can get a 210MB version for about $100 more), Compaq's own 1.44MB floppy disk drive, a 10.4-inch Sharp-manufactured active-matrix 256-color VGA display with 512K of video RAM, a full array of ports, two full-length EISA slots, and a well-constructed, full-size 101-key keyboard. Unfortunately, only Compaq's utilities and drivers come free of charge; DOS and Microsoft Windows are extra. Other options include extra parallel and serial interface boards, an external expansion module, an Enhanced keyboard, a 2,400-bps data modem, and a carrying case.

SUITABILITY TO TASK

Compaq Portable 486C

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

The light-beige 17-pound system, which measures 5.5 by 15.6 by 11 inches, is sturdily constructed and topped by a surprisingly usable handle. All the ports are hidden behind a sliding rear door, and the display swivels to the desired viewing angle (rather than being lifted on tiny feet, as are the Dolch systems).

Compaq didn't skimp on performance, either. While the Portable 486C placed among the top four 486-based portables on all our benchmark tests, its video accomplishments really stood out. It garnered first-place scores (with a significant lead) on our video and Graphics Winmark tests.

The Portable 486C is sold through Compaq's distributor channels and comes with a one-year warranty on parts and labor and a wide range of support, including a toll-free technical-support line. For those of you who need all this power without color or who can't afford the Compaq Portable 486C, Compaq has introduced a monochrome active-matrix version that starts at $5,899.—*Oliver Rist*

FACT FILE

EDITORS' CHOICE

Compaq Portable 486C

Compaq Computer Corp., 20555 Farm Hwy. #249, Houston, TX 77070; 800-231-0900, 713-370-0670; fax, 800-345-1518

List price (tested configuration): $9,017

Tested Configuration: 6MB RAM, 120MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0

Options: 2MB RAM upgrade, $219, 4MB RAM upgrade, $439, 8MB RAM upgrade, $699, upgrade to 210MB hard disk, $1,000, external floppy disk drive (360K or 1.2MB), $275, 2,400-bps modem, $319, carrying case, $89

470 ON READER SERVICE CARD

Dell Computer Corp.

Dell System 325NC

At $3,898 for a comfortable configuration—4MB of RAM, an 84MB hard disk, DOS 5.0, Microsoft Windows 3.1, and a mouse—the Dell System 325NC doesn't boast a bargain basement price. But if you've got the spare change, the extra cost buys you a well-made color notebook that doesn't cramp your shoulder, lasts up to 5 hours on battery power, and has a passive-matrix color display that is a pleasure to work on.

The System 325NC puts an Intel 386SL/25 with 64K of SRAM cache inside a charcoal-gray 2.5- by 11- by 8.5-inch case. Weighing 7.3 pounds with its battery, our evaluation unit was configured with a very fast 16-millisecond Quantum Go* Drive 80MB hard disk (complete with a 32K buffer) and a 1.44MB floppy disk drive to the right of the keyboard. A Western Digital WD90C22/WD90C55 chip set drives the 9.3-inch-diagonal, passive-matrix color, edgelit VGA display from Sharp. The unit can also drive an external display at 800-by-600 with 16 simultaneous colors at 60 Hz.

The System 325NC performed in the top quarter of its processor class and generally outperformed its closest competitor, the AST Premium Exec 386SX/25C. For example, the System 325NC beat the Premium Exec 386SX/25C on the Graphics Winmark test by over 20 million pixels per second. At 2 hours 53 minutes (with all power-conservation features disabled), the life of the System 325NC's nickel hydride battery exceeds the battery life of most monochrome models as well as its color competitors; on our tests, enabling

SUITABILITY TO TASK

Dell System 325NC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	●
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

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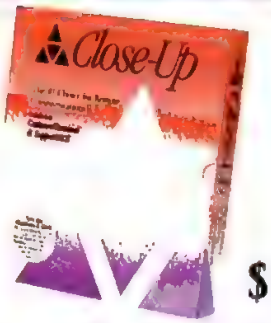

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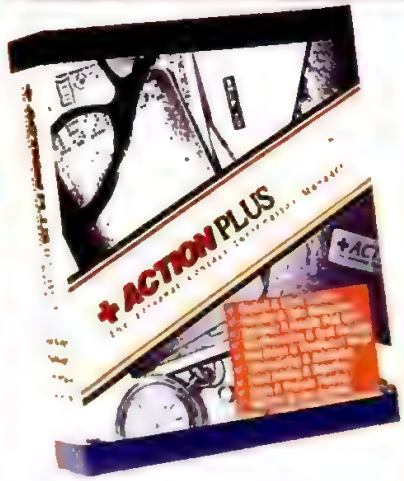

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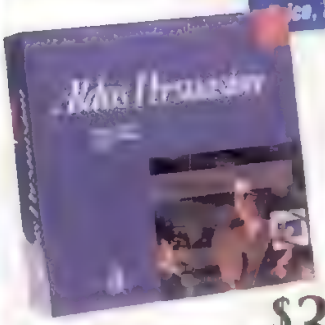

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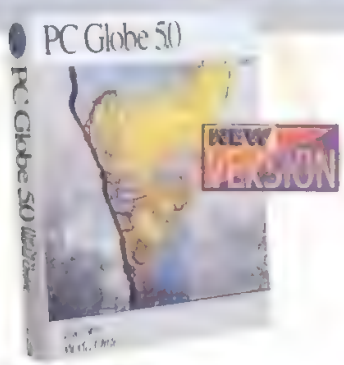

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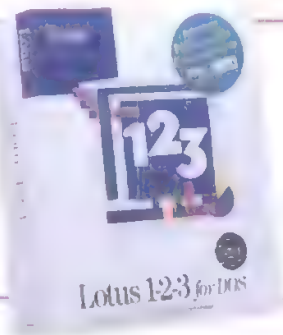
All the applications in SmartSuite are designed to work together in Windows so you can pass information from one program to another effortlessly. Lotus 1-2-3 database management, Freelance Graphics design, Ami Pro word processing and electronic messaging with cc:Mail are all included. Lotus #10655-5.25" disk • #10656-3" disk



Lotus 1-2-3 2.4 $334

1-2-3 delivers the latest graphical and analytic capabilities to DOS spreadsheet customers and Lotus' installed base of more than 14 million users. Designed for computer users looking for a fast, graphical spreadsheet that runs on all PCs. Lotus •
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$58 Adobe TypeManager 2.0

WYSIWYG isn't WYSIWYG without Adobe Type Manager. And now, you can adjust kerning and leading on screen—and see it before you print. ATM solves the problems of jagged edges—no more 24-point headlines that look like brick piles. The entire PostScript font library works with ATM. It also supports Bitstream fonts and the Hewlett Packard laser printer. Adobe • #07319

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Bookman Light Italic	ITC Souvenir Light Italic
Bookman Demi	ITC Souvenir Demi
Bookman Demi Italic	ITC Souvenir Demi Italic
Itc Quadrata	Stone Sans
Itc Quadrata Bold	Stone Sans Italic
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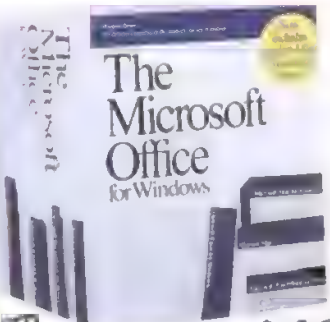
Korinna Kursiv Regular	Stone Sans Semibold Italic
Korinna Bold	Stone Sans Bold
Korinna Kursiv Bold	Stone Sans Bold Italic



$484 The Microsoft Office 2.5

Microsoft Office provides complete office automation in one package. It comes with four essential business productivity applications—Microsoft Word for Windows (word processing), Microsoft Excel for Windows (spreadsheet), Microsoft PowerPoint for Windows (presentation) and Microsoft Mail (electronic mail). Microsoft Corp.
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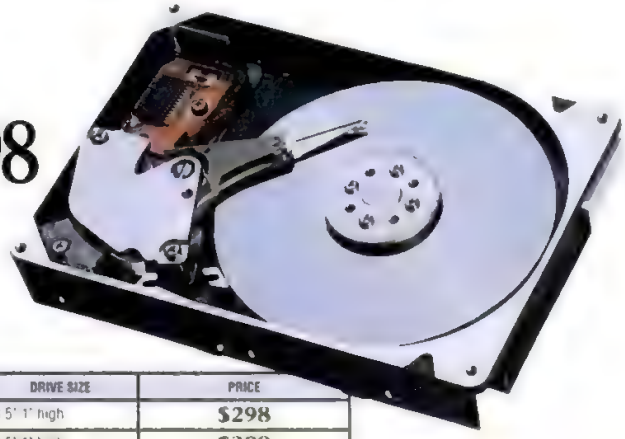

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Unsurpassed performance and design characterize Maxtor's family of 1-inch high, 3.5-inch hard disk drives. This 130MB model is ideal for use in mobile or desktop computer systems. Firmware control allows reduction of power consumption to just 0.1 watt. Other features include 150,000 hour MTBF, 64K cache, 1:1 interleave, automatic actuator lock, embedded servo, and high performance rotary voice coil. Maxtor • #10665

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#10665	MXT-7120A	130.4Mb IDE	15ms	3.5"/1" high	$398
#10662	MXT-7213A	213.0Mb IDE	15ms	3.5"/1" high	$528
#10663	MXT-340A	340.0Mb IDE	15ms	3.5"/1.625" high	$998
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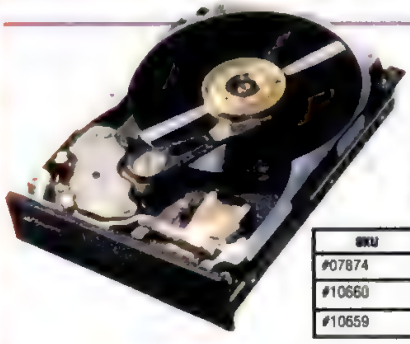

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The Seagate ST3144 is a 131Mb model with 32Kbytes SeaCache buffer. This unit features the advanced dedicated servo design with thermal compensation and a patented straight arm actuator with magnetic lock. With a 16 millisecond average seek, the ST3144 offers top performance and value. Seagate • #10660

SKU	MODEL #	FORMATTED CAPACITY	AVERAGE ACCESS	DRIVE SIZE	PRICE
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#10660	ST-3144A	130.7MB	16ms	3.5"/1" high	$398
#10659	ST-3283A	245.3MB	12ms	3.5"/1" high	$754

Multimedia: for the Eyes, Ears and Mind

Pro 16 MultiMedia System $998

This high performance system includes the Audio Spectrum 16 board and the double speed NEC SCSI CD-ROM drive. This combination offers twice the throughput (300KB/sec) and over three times faster average access time (280 ms) of other upgrade kits. It's even bundled with all the same software included with the Multimedia Upgrade Kit Plus. Media Vision • #10692

MultiMedia Upgrade Kit Plus • #10567 ..... $864

Pro AudioSpectrum 16 $228

This professional multimedia sound program is the latest of its kind. It offers true 16 bit stereo sound—playback, input and sampling. Compatible with the most popular sound software available, it also comes with extra bundled software; a MIDI sequencer, four track sampling application and more. Media Vision • #10568

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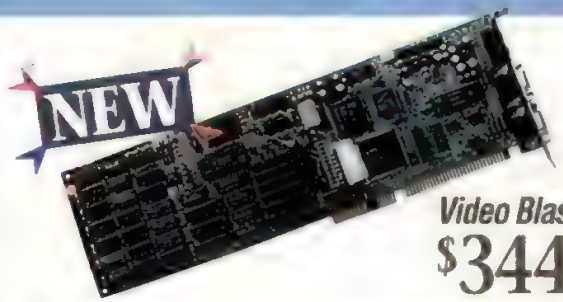
NEC's CDR-84 is the fastest internal CD-ROM drive to date. With new MultiSpin technology, you get typical access speeds of 280 milliseconds and data transfer rates of 300Kbytes/second. These drives are unrivaled for speed of access and data transfer. And every NEC CD-ROM drive we sell includes the XTAT interface kit, with cable and card. It's all you need for the speed of an NEC CD-ROM drive. NEC • #11120



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This high-powered card integrates video and audio sources from a video disc, VCR or camera, and combines them with VGA graphics to create a brand new world of multimedia presentations. Digitize and capture video images from these sources through the Video Blaster for use with your favorite presentation, animation, or even data base application. Requires VGA. Creative Labs #10728

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LANtastic EN Starter Kit #142 4.1 $488

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LANtastic EN Adapter Card #143 • #09133 $208
LANastic Z Two Station 4.1 • #07968 $88

Xircom Network Simplicity Starter Pack $668

Novell's Netware Lite is the software, and Xircom's pocket ethernet adapters are the hardware. Together, this package gives you everything you need to simply network two PCs whether they are laptops, notebooks or desktop types. The software guides you through complete installation and configuration. Includes E-mail and Novell's Netware Lite. Xircom #10729-5.25" disk • #10731-3.5" disk

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#09332	HC2400R	Zoom 2400 Int	$68
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#10646	VPV 32bis	Zoom 14.4 Int	$268

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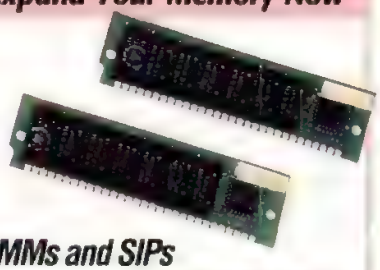

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FACT FILE

Dell System 325NC

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-4400; 800-426-5150, 512-338-4400; fax, 800-727-8320

List price (tested configuration): $4,047.

Tested Configuration: 4MB RAM, 80MB Quantum Go*Drive hard disk, 1.44MB floppy disk drive, 9,600-bps fax modem, Microsoft BallPoint Mouse, DOS 5.0, Microsoft Windows 3.1.

Options: 2MB RAM upgrade, $180; 4MB upgrade, $330; 8MB upgrade, $600; extra battery, $169; Cyrix math coprocessor, $149; Intel math coprocessor, $199; battery charger, $269; 9,600-bps fax modem, $149; 9,600-bps MNP 5 fax modem, $299; 9,600-bps data/fax modem, $599; carrying case, $99

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conservation features such as the hard disk and LCD time-outs extended that time by more than 2 hours.

You can set the unit to ignore the various standby modes when running off the AC adapter, a real nerve-saving feature. The keyboard has a nice touch and a generally good layout. The only exception is the positioning of the Home and Backspace keys; those used to larger keyboards will find themselves overreaching and going home instead of deleting.

Options include additional system memory (2MB to 8MB), a math coprocessor, an external tape-backup unit, an external numeric keypad, spare batteries, an auto adapter, an external battery charger, and a carrying case. Using a 60MB hard disk instead of an 84MB unit lowers the price by $300. Dell Computer Corp. backs its Dell System 325NC with a one-year warranty on parts and labor, on-site service from BancTec, and toll-free technical support.—*Lori Grunin*

Dolch Computer Systems

Dolch P.A.C. 486-50E
Dolch P.A.C. 486-33E
Dolch P.A.C. 386-33C

Weighing 21 pounds and toting a $16,937 price tag, the active-matrix Dolch P.A.C. 486-50E is the heavyweight champion of luggable EISA systems and the top of Dolch Computer Systems' Portable Add-in Computer (P.A.C.) line. If you need maximum power in a color portable, the P.A.C. 486-50E delivers a serious performance punch.

The unit's 50-MHz 486DX powered its way to first place on our processor test, as expected, but Dolch's other components garnered honors as well. The 8MB of 70-nanosecond SIMMs (along with a 128K secondary SRAM cache) and 420MB Quantum SCSI hard disk (with DTC's 329B 4MB SCSI caching disk controller) scored first place on the memory and disk tests, respectively. This notebook lagged behind only on the video test: Its score came in dead last among 486-based portables, and its Graphics Winmark score was also near the bottom. The beautiful 10.5-inch active-matrix TFT (thin film transistor) color screen from Hitachi, however, deserves a compliment for its stunning images.

Externally, the P.A.C. 486-50E supports 16 simultaneous colors in 800-by-600 and offers a palette of 65,000 colors in VGA mode. The Chips & Technologies F82C457 video chipset has obviously been tweaked to emphasize color, not speed. The P.A.C. 486-50E runs off AC power only (on a 73-inch cord), so it could not run our battery-life tests.

This huge, 9.5- by 15.5- by 8.5-inch portable arrived with 4MB of RAM standard (expandable to 32MB of DRAM in 4MB SIMMs) on the system board, a choice of either a Quantum SCSI hard disk (240MB or 420MB) or a Conner 120MB IDE unit, and a 1.44MB TEAC floppy disk drive. Its 8.3-MHz EISA bus comes with six full-length 32-bit expansion slots (three were filled), a Weitek coprocessor socket, and a full complement of I/O ports. There is also a detachable 86-key keyboard—a solid unit with full-height keys, an inverted-T cursor-key layout, and separate Home, End, PgUp, and PgDn keys.

SUITABILITY TO TASK

	POOR	FAIR	GOOD	EXCELLENT
Dolch P.A.C. 486-50E				
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●
Dolch P.A.C. 486-33E				
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●
Dolch P.A.C. 386-33C				
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

THE DOLCH P.A.C. 486-33E, AND THE DOLCH P.A.C. 386-33C

In keeping with its heavy stance in the powerful portables market, Dolch also sent us two other versions of its P.A.C. luggable series—the Dolch P.A.C. 486-33E ($15,442) and the Dolch P.A.C. 386-33C ($12,511). These two rugged boxes differed mainly in processing punch, but each 19-pound unit performed well—albeit at a high price.

Similar in design to the P.A.C. 486-50E, these AC-only systems feature the same vibrant 10.5-inch Hitachi TFT (thin film transistor) active-matrix color display. They hold

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PC MAGAZINE EDITORS' CHOICE March 17, 1992 Northgate Elegance 433e

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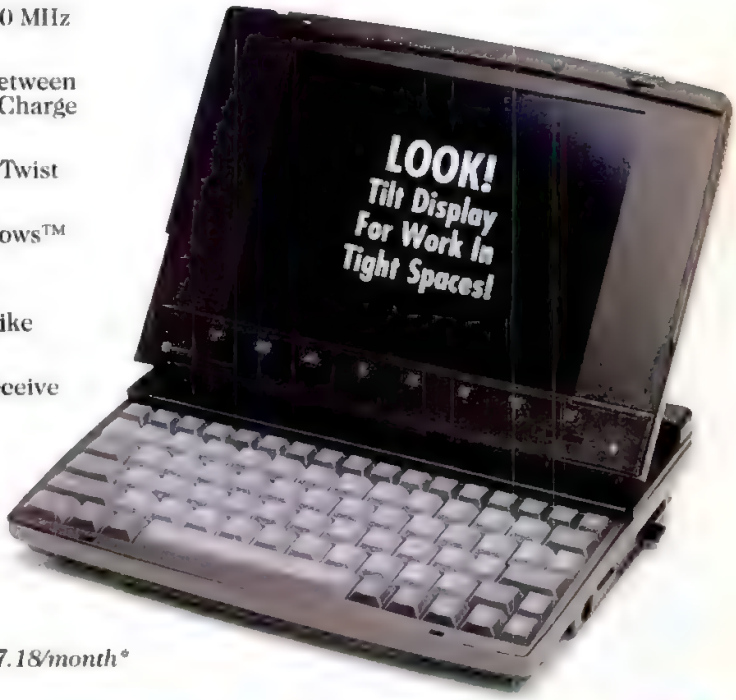

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"Northgate earned the highest score for satisfaction with technical support among this survey's 35 desktop manufacturers . . . On satisfaction with technical support, Northgate's 486-based desktops . . . received a significantly higher rating than those of the other 486 manufacturers: Compaq, Gateway 2000, IBM and Zeos."

— PC Magazine, May 26, 1992

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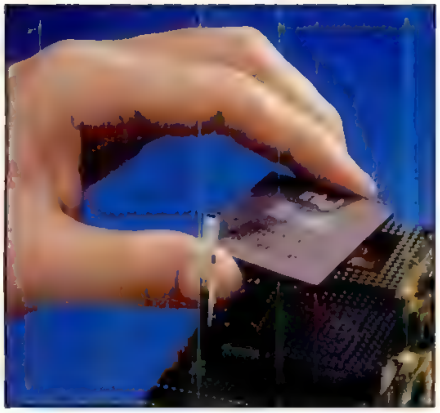

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Elegance ZXP 486/33 Configuration

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FACT FILE

Dolch P.A.C. 486-50E

List price (tested configuration): $16,937

Tested Configuration: 8MB RAM, 420MB Quantum hard disk, DTC SCSI controller with 4MB cache, 1.44MB floppy disk drive, DOS 5.0

Options: 4MB RAM upgrade, $376; upgrade to 240MB hard disk, $388; upgrade to 420MB hard disk, $1,628, DTC SCSI controller with 4MB cache, $1,570; 2,400-bps modem, $124; carrying case, $60

Dolch P.A.C. 486-33E

List price (tested configuration): $15,442

Tested Configuration: 8MB RAM, 420MB Quantum hard disk, DTC SCSI controller with 4MB cache, 1.44MB floppy disk drive, DOS 5.0.

Options: same as Dolch P.A.C. 486-50E

Dolch P.A.C. 386-33C

List price (tested configuration): $12,511.

Tested Configuration: 8MB RAM, 420MB Quantum hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: same as Dolch P.A.C. 486-50E

Dolch Computer Systems, 372 Turquoise St., Milpitas, CA 95035; 800-538-7506, 408-957-6575; fax, 408-263-6305

472 ON READER SERVICE CARD

up to 32MB of RAM, and they come with a choice of either a 120MB Conner IDE hard disk or a 240MB or 420MB Quantum SCSI hard disk, a 1.44MB TEAC floppy disk drive, all the requisite ports except a PS/2 mouse port, and the same detachable 86-key keyboard inside the same charcoal-gray 9.5- by 15.5- by 8.5-inch case. The P.A.C. 486-33E holds six EISA expansion slots, but the P.A.C. 386-33C is a six-slot ISA system. Both had three free slots as tested. With all this room, you can configure these two systems to meet your own needs; for instance, a multimedia version is possible with a built-in CD-ROM drive and a SoundBlaster audio card.

The P.A.C. 486-33E and P.A.C. 386-33C performed well: The former also configured with a 420MB Quantum SCSI hard disk and a DTC EISA SCSI-2 controller with 4MB of cache, finished second on our disk test, behind the P.A.C. 486-50E. Using the same drive with a 256K cache, the P.A.C. 386-33C took a wide lead. But all was not rosy. Like the P.A.C. 486-50E, both units use the Chips & Technologies F82C457 video chip set and performed poorly on our video test.

Dolch ships its units mainly through distributors. It offers only two accessories besides internal system hardware: a 2,400-bps modem and a large sturdy carrying case. Dolch sells its portables with a one-year warranty on parts and a two-year warranty on labor. A toll-free technical-support number is also available. *—Oliver Rist*

IBM Corp.

IBM PS/2 Model CL57SX

The IBM PS/2 Model CL57SX, one of the newest members of PS/2 series, is an active-matrix color laptop based on the Intel 386SX/20. Our $6,410 test unit came with 4MB of RAM (expandable to 16MB), no external RAM cache, and a 16-millisecond 80MB IBM ESDI hard disk loaded with DOS 5.0. Though it was a competitive performer on our benchmark tests, the PS/2 Model CL57SX had the worst battery life of any system we tested, and at 11.4 pounds with limited expansion, this machine is neither notebook nor expandable luggable. Even with color, this system simply costs (and weighs) too much for a 386SX/20 laptop.

SUITABILITY TO TASK
IBM PS/2 Model CL57SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	○	○
Windows applications	●	●	○	○
Desktop replacement	●	●	○	○

Because of its large size, the 3- by 13- by 11-inch PS/2 Model CL57SX is not a true notebook and would be difficult to use on the road. Add the 2-pound, 2- by 8- by 3.5-inch battery charger and you will be hard-pressed to fit everything inside your briefcase. Its large active-matrix display, IBM Corp.'s Communications Station (a $375 external module that clips on to provide either Token-Ring, Ethernet, or 3270 support), and its standard-size keyboard make the PS/2 Model CL57SX better suited as a desktop replacement with a limited travel life. The 80MB hard disk is the only size available.

IBM PS/2 Model CL57SX

FACT FILE

IBM PS/2 Model CL57SX

IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-772-2227

List price (tested configuration): $6,410

Tested Configuration: 4MB RAM, 80MB IBM hard disk, 1.44MB floppy disk drive, DOS 5.0, integrated trackball

Options: 4MB RAM upgrade, $825; 8MB RAM upgrade, $1,645; extra battery, $185; battery charger, $325; 9,600-bps fax modem, $365; carrying case, $114.

The non-RAM-cached PS/2 Model CL57SX registered average scores on our processor, memory, and hard disk tests. Its strongest feature, however, is its IBM video subsystem. A proprietary video chip set combined with a 10.7-inch active-matrix display from Display Technologies—the Toshiba-IBM (Japan) joint venture—made this system not only easier to view but a screamer as well on our video and Graphics Winmark tests. The 12-volt nickel hydride battery, however, had the shortest battery life: 1 hour 9 minutes on our ZDigit Rundown test and 50 minutes on the Battery Rundown test.

The PS/2 Model CL57SX accepts a PS/2-compatible mouse but also offers an integrated mini-trackball. The trackball is positioned so close to the top right of the keyboard, however, that it's all too easy to hit the keys instead. The keyboard itself, with full-size keys, is very responsive.

You can purchase a PS/2 Model CL57SX from your local IBM dealer. A 4MB memory upgrade is ridiculously priced at $825, while a 9,600-bps send-only fax modem costs a more reasonable $365. Your dealer should handle any warranty questions, but IBM does cover the unit with a one-year parts-only warranty. The company also offers toll-free technical support. *—William Bettini*

IT LOOKS LIKE YELLOW JOURNALISM TO US.

If Dell Computer paid $4,778 for a Toshiba T2200SX, we'd like to suggest they never wander into a used car dealership.

Because at participating Intelligent Electronics dealers, the actual price of a Toshiba T2200SX is only $2,699. According to our math, that's $2,079* less than Dell claims it costs.

More importantly, that means the T2200SX is cheaper than the Dell 325NC. And even though

T2200SX with 4MB RAM, actual price.

Dell just lowered their price, Toshiba is still $600* cheaper.

Of course, that's not the only information they neglected to give you. For instance, the T2200SX is a pound and a half lighter and almost 30 percent smaller than Dell's computer. Toshiba offers standard key spacing versus Dell's squeezed keys. And Toshiba's award-winning T2200SX allows you expansion capabilities with a desktop docking station. Dell, naturally, doesn't.

As for Dell's so-called color screen, consider that it's a passive matrix LCD whereas Toshiba offers several computers in its line that feature brilliant 256-color TFT active matrix screens.

And those are the facts, in plain black and white.

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*We don't want to mislead you. Since 5/1/92, Dell has lowered the price of the 325NC/60 from $3999 to $3299, and Toshiba has lowered the suggested retail price of the T2200SX/80 (with standard 2MB RAM) from $3499 to $3099. Funny how our price still beats Dell's. 102501

CIRCLE 273 ON READER SERVICE CARD

Micronics Computers Inc.

Mport 450/Color Mpression

The $12,795 Micronics Computers' Mport 450/Color Mpression, an expensive system but a good value, is geared almost exclusively to those who rely on color overhead presentations. The AC-only, 14.6-pound Mport 450 is unique for a couple of reasons. First, it is the only system centered around a 50-MHz Intel 486DX2 processor. Second, this color system is really an overweight monochrome laptop bundled with a separate active-matrix color presentation panel designed only for those who give frequent presentations on the road.

Micronics' Color Mpression, a 3.8-pound projection panel incorporating Sharp's active-matrix display, plugs into the Mport 450's parallel port, which doubles as the overhead LCD's video-out port. Aesthetically, the Color Mpression combined with an overhead projector produces vivid color images with up to 256 simultaneous colors. While a good color presentation panel costs as much as $7,000, the high price of this notebook and panel places this package in the niche market.

Our test unit came with 8MB of RAM (expandable to 32MB), a 230MB Quantum ProDrive IDE hard disk (120MB is also available), a 1.44MB floppy disk drive, a 10-inch monochrome Sanyo LCD panel, room for one full-length ISA expansion card, DOS 5.0, and Microsoft Windows 3.1. Micronics provides a one-year warranty on parts and labor; technical support requires a toll call.

The Mport 450's performance on our tests was generally strong—the 50-MHz DX2 outstripped all of the 486DX/33 competitors on processor and memory tests—but its video performance was below average.

The 4- by 16- by 12.3-inch case is smaller than the cases of most of the other portables included here and comes with a sturdy handle, but the system's travel weight is a substantial 18.4 pounds. The full-size 82-key keyboard has full key travel and features separate Home, End, PgUp, and PgDn keys and an inverted-T cursor-key layout. The ports and power switch, though, are rear-mounted and exposed.—*Oliver Rist*

SUITABILITY TO TASK

Mport 450 Color/Mpression

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	○	○

FACT FILE

Mport 450/Color Mpression

Micronics Computers Inc., 232 E. Warren Ave., Fremont, CA 94539; 800-659-5901, 510-651-2308; fax, 510-651-5612

List price (tested configuration): $12,795
Tested Configuration: 8MB RAM, 230MB Quantum hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1, mouse, carrying case.
Options: 2MB RAM upgrade, $100

173 ON READER SERVICE CARD

NEC Technologies Inc.

NEC ProSpeed 486SX/C
NEC ProSpeed 486SX
NEC UltraLite SL/25C

NEC Technologies' NEC ProSpeed 486SX line inaugurated color in portables—at first with passive-matrix technology and later with active-matrix color. Now NEC has come up with another new twist: a monochrome active-matrix twin.

The 20-MHz, AC-only, EISA-based NEC ProSpeed 486SX/C comes with 2MB of RAM (expandable to 20MB), a 120MB NEC hard disk (a 240MB kit costs $849), a 1.44MB floppy disk drive, a choice of either a color or monochrome 10.4-inch active-matrix display, DOS 5.0, Microsoft Windows 3.1, and an AC adapter and brick power supply. The tested systems cost $8,099 for a color unit with 2MB of RAM and $7,073 for a monochrome system with 8MB of RAM, respectively, although on identical systems color costs roughly $1,500 more. With the tested configuration, a color unit (the ProSpeed 486SX/C) with 2MB of RAM costs $8,099, and a monochrome system (ProSpeed 486SX) with 8MB of RAM costs $7,073.

The 17.3-pound, 4.3- by 15.5- by 14.8-inch system has one full-size EISA slot open. There is room for an internal modem, and an expansion port lets you connect the five-bay docking station with seven ISA slots. When you add an external monitor, the ProSpeed can display 16 colors in resolutions up to 1,024-by-768 through its external video port.

Its processor and hard disk scores were solidly average for its class, and its memory score was not significantly below average. On the video test, it scored among the fastest of the 486 crowd for both the color and monochrome versions. Active-matrix color was fantastic on the Hitachi color display; active-matrix monochrome was crystal-clear with no ghosting. Since the ProSpeed 486SX/C is an AC-only portable, it did not run our battery tests.

SUITABILITY TO TASK

NEC ProSpeed 486SX/C

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

NEC ProSpeed 486SX

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

NEC UltraLite SL/25C

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	○	○
DOS applications	●	●	●	○
Windows applications	●	●	●	○
Desktop replacement	●	●	●	○

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CIRCLE 231 ON READER SERVICE CARD

Numerous rugged plastic doors provide easy access when upgrading this well-constructed unit. The 91-key keyboard is solidly made, with full-size keys and deep key travel. A rugged, built-in handle eliminates the need to buy the separate carrying case. If you are looking for desktop expansion possibilities and 486SX power, a machine from the ProSpeed 486SX line is a deserving but expensive candidate.

NEC UltraLite SL/25C

The $5,999 NEC UltraLite SL/25C was the first battery-powered notebook to deliver active-matrix color (for our review, see First Looks, January 14, 1992), and it remains a strong competitor in the active-matrix color notebook market. But with stiff competition from the Toshiba T4400SXC and future active-color notebooks, NEC's portable rainbow may be fading fast.

The 7.5-pound UltraLite SL/25C has Intel's low-power 386SL/25 processor and comes with all the trimmings: 2MB to 10MB of RAM, a 64K RAM cache, an 80MB or 120MB Quantum IDE hard disk, a 1.44MB floppy disk drive, a 9.5-inch active-matrix color screen manufactured by NEC, a 78-key keyboard, DOS 5.0, and Microsoft Windows 3.1. Ports include parallel, serial, PS/2 mouse, external keyboard, numeric keypad, and an interface for a $899 docking station. There is room for a math coprocessor and either an internal 2,400-bps modem or a 9,600-bps fax modem; NEC lacks a high speed data modem for now. A carrying case costs $89, but a two-year warranty on parts and labor and a technical-support hot line are free.

The UltraLite SL/25C's performance results are what you would expect from a $6,000 machine. The 64K SRAM four-way set-associative write-through cache helped bring in fast processor and memory scores. The Quantum Go* Drive IDE hard disk, though, rated at a mere 16 milliseconds, soared into second place among 25-MHz SX-based systems by a wide margin, thanks to Quantum's 32K DisCache and WriteCache firmware. The

FACT FILE

NEC ProSpeed 486SX/C
List price (tested configuration): $8,099
Tested Configuration: 2MB RAM, 120MB NEC hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1
Options: 1MB RAM upgrade, $129; 4MB RAM upgrade, $449, upgrade to 240MB Quantum hard disk, $849, math coprocessor, $719; 2,400-bps modem, $299, 9,600-bps fax modem, $499, standard carrying case, $49, deluxe carrying case, $109

NEC ProSpeed 486SX
List price (tested configuration): $7,073
Tested Configuration: 8MB RAM, 120MB NEC hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1
Options: same as NEC ProSpeed 486SX/C

NEC UltraLite SL/25C
List price (tested configuration): $5,999
Tested Configuration: 2MB RAM, 80MB Quantum hard disk, 1.44MB floppy disk drive, DOS 5.0, Microsoft Windows 3.1
Options: 2MB RAM upgrade, $299, 4MB RAM upgrade, $699, 6MB RAM upgrade, $1,099, 8MB RAM upgrade, $1,499, upgrade to 120MB hard disk, $400; 2,400-bps modem, $299, 9,600-bps fax modem, $499, portable docking station, $899, carrying case $89

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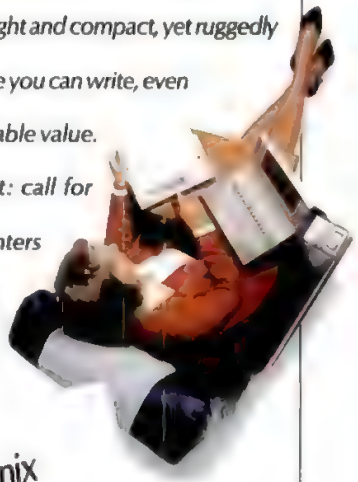

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KODAK *Kodak Diconix printers*

CIRCLE 362 ON READER SERVICE CARD

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Cirrus 6410 chip set's video scores were also good. Only battery performance was disappointing. The UltraLite SL/25C's nickel cadmium batteries lasted just 1 hour 11 minutes on our Battery Rundown test and 2 hours 17 minutes on our ZDigit Rundown test.

Despite its poor battery performance, our impressions of the 2.5- by 11.5- by 9.5-inch machine remain mostly positive, although some drawbacks deserve mention. First, it is big and definitely not light. Also, the UltraLite SL/25C's colors were not as bright as those of its strongest competitor, the Toshiba T4400SXC. This may be due to its 16-simultaneous-color limit on-screen, compared with the 256-color support of the competition, as well as less effective backlighting. Image controls were limited to a single brightness slide on the display face.

The keyboard could stand improvement. Although in an inverted-T layout, its cursor keys are half-size and also double as PgUp, PgDn, Home, and Endkeys. A full complement of ports is secured behind two strong plastic doors located in the rear, and the display hinge is solid.

NEC's support policy includes the standard one-year warranty on parts and labor offered by most of the competitors. On-site service is available through dealers, but NEC can be contacted via an 800 number on weekdays from 8:30 to 7 E.S.T.—*Oliver Rist*

Toshiba America Information Systems Inc.

Toshiba T6400DXC
Toshiba T6400SXC
Toshiba T4400SXC

With its T6400 series, Toshiba America Information Systems is targeting the high-end portable-workstation market, which was until now dominated by Compaq and Dolch luggables. Unlike these pioneers, however, Toshiba has refined this well-designed active-matrix system to fit tightly into your briefcase. The Toshiba T6400DXC and Toshiba T6400SXC have a solid feel, good performance, and all the options you could want. Only their prices may make you hesitate.

In spite of being smaller than the Compaq and Dolch luggables, the AC-only T6400s don't skimp. Each 12.6-pound system is available with either a 486DX/33 ($9,948) or 486SX/25 ($8,648) processor and your choice of a 120MB Conner CP-30104 or 200MB Conner CP-30204 hard disk. Solidly constructed, the 4.5- by 15.5- by 10.5-inch T6400 arrives with at least 4MB of 65-nanosecond DRAM (expandable to 20MB), a 1.44MB floppy disk drive, a removable 101-key keyboard, and a gorgeous Toshiba trademark: a 10.4-inch active-matrix TFT (thin film transistor) color LCD screen. In addition to the requisite ports, which include a PS/2 mouse and an external keyboard port, Toshiba provides a 150-pin external port for future expansion possibilities, including a SCSI interface that should be available soon. The T6400 has room for an internal modem as well as one full-length 16-bit and one half-length 8-bit expansion card. Neither unit supports a coprocessor.

On our performance tests, the T6400 chased its Dolch competition the entire

SUITABILITY TO TASK

Toshiba T6400DXC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Toshiba T4400SXC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	●	●	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

Toshiba T6400SXC

	POOR	FAIR	GOOD	EXCELLENT
Road warrior/communications	●	○	○	○
DOS applications	●	●	●	●
Windows applications	●	●	●	○
Desktop replacement	●	●	●	●

FACT FILE

Toshiba T6400DXC

List price (tested configuration): $9,948.

Tested Configuration: 4MB RAM, 200MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, $435; 4MB RAM upgrade, $699; 8MB RAM upgrade, $1,335; external 1.2MB floppy disk drive, $399; external tape backup drive, $849; numeric keypad, $79; 2,400-bps modem, $199; 2,400-bps V.42bis modem, $259; standard carrying case, $105; leather carrying case, $239.

Toshiba T6400SXC

List price (tested configuration): $8,648.

Tested Configuration: 4MB RAM, 120MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: same as Toshiba T6400DXC.

Toshiba T4400SXC

List price (tested configuration): $7,699.

Tested Configuration: 4MB RAM, 85MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0.

Options: 2MB RAM upgrade, $435; 4MB RAM upgrade, $699; 8MB RAM upgrade, $1,335; external 1.2MB floppy disk drive, $399; external tape backup drive, $849; numeric keypad, $79; extra battery, $345; battery charger with AC power adapter, $289; AC power adapter, $185; car battery adapter, $199; keyboard adapter, $159; 2,400-bps modem, $199; 2,400-bps V.42bis modem, $259; desk station, $999; executive portfolio, $105; standard carrying case, $79; leather carrying case, $239.

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TURBO
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486

HOT NEW ZEOS®
'386 AND '486 SYSTEMS!

PC Magazine calls it "the ultimate-power desktop PC." What will you call your new *ZEOS '486 Editors' Choice* system? Probably the hottest computer you've ever owned!

First of all, our prices are great! You can get a ZEOS 386-33 upgradable for as little as $1,295. Or you can move right into a *complete 486DX-50MHz for only $1,995.* Outrageous! And it's not just the price. It's all the extras we give you, too.

As an example, your new ZEOS Windows system comes complete with your choice of two out of three great Windows applications: *Lotus 1-2-3 for Windows, Ami Pro 2.0,* and *Freelance Graphics.* These are not trial copies or sample disks, they are full-blown, fully documented production packages. And, with a suggested retail of close to $1,000, even at "street prices" that's a *great* value. It's ZEOS value. Here's another great value example.

You have probably heard about the importance of protecting your new computer investment with a surge suppressor. Well, your new ZEOS upgradable desktop system already has one. *Built into the power supply!*

ZEOS. Nine times Editors' Choice. Your Best Choice as Well!

That's innovation, built in from ZEOS.

Here's another innovation we introduced to the hardware industry. *24-Hour-a-Day Toll-Free Technical Support.* While most of the others still only offer part-time technical support, as a ZEOS customer, you get around-the-clock 24-hour-a-day support, 365 days a year. Not that you'll need the help. But it's comforting to know if you do have a question, all you have to do is pick up the phone and give us a call, *any time* of the day or night!

Upgradable. Low Cost.

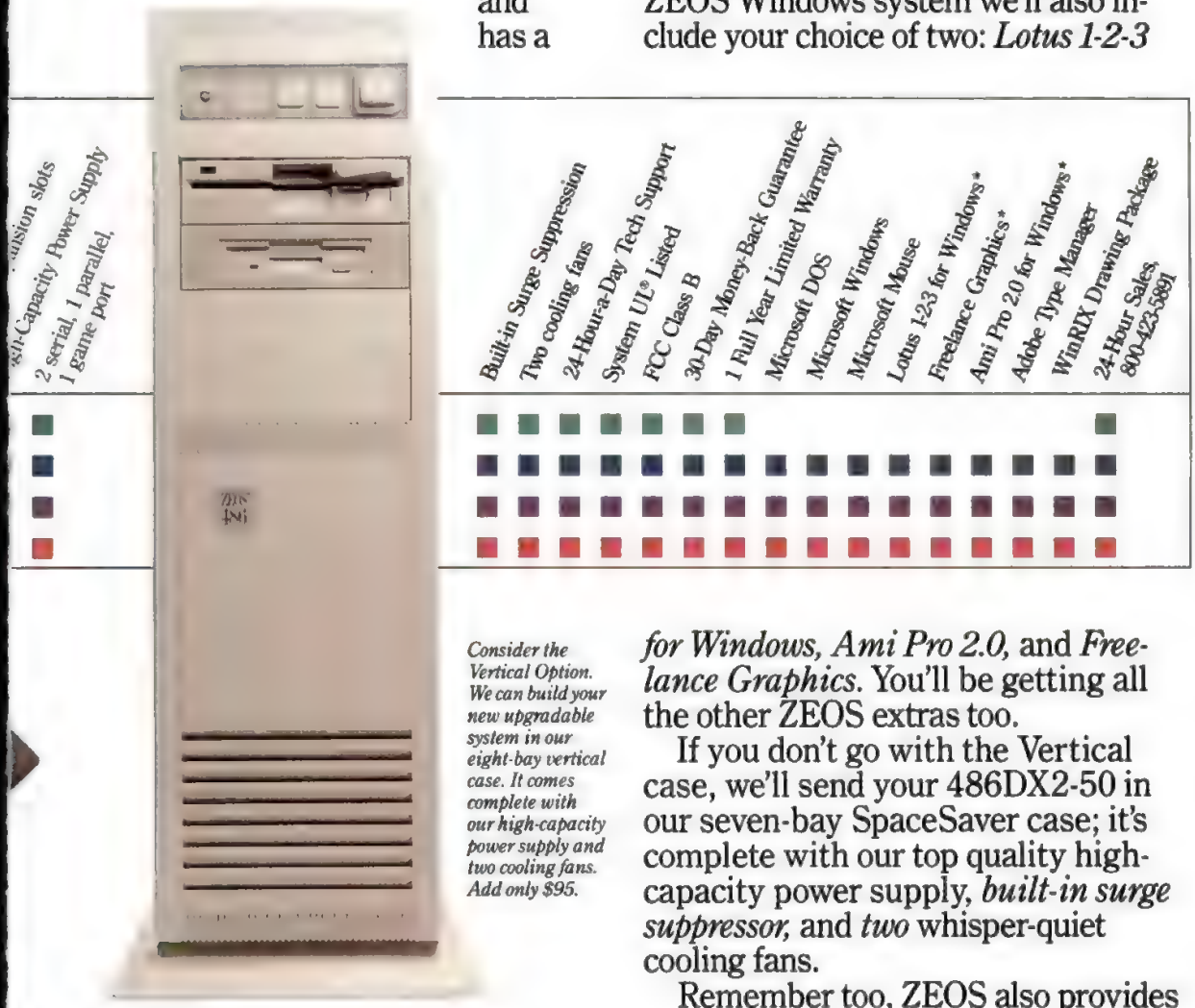
And all of this is just for starters. Because when you turn the page we're going to talk about a lot of other very exciting and important reasons for you to buy from ZEOS. Like 486SX-25s, the new 486DX-50s, your ZEOS *Editors' Choice '486* and more. *Come on in!*

Packages #3 and #4 incorporate these suggestions.

Certainly another option you may want to consider is our Vertical case. This heavy-duty case holds more drives than most others and has a top-notch power supply and plenty of cooling.

YOUR ZEOS EXTRAS. NO EXTRA CHARGE.

And don't forget, if you purchase a ZEOS Windows system we'll also include your choice of two: *Lotus 1-2-3 for Windows, Ami Pro 2.0,* and *Freelance Graphics.* You'll be getting all the other ZEOS extras too.



Consider the Vertical Option. We can build your new upgradable system in our eight-bay vertical case. It comes complete with our high-capacity power supply and two cooling fans. Add only $95.

If you don't go with the Vertical case, we'll send your 486DX2-50 in our seven-bay SpaceSaver case; it's complete with our top quality high-capacity power supply, *built-in surge suppressor,* and *two* whisper-quiet cooling fans.

Remember too, ZEOS also provides you with 24-Hour Support, our 30-Day Money-Back Guarantee, One Full Year Limited Warranty and our Express Parts Replacement Policy.

Ordering your new ZEOS is easy. Simply give us a call. You're going to love your new ZEOS '50. And that's a guarantee! *Call now Toll Free 800-423-5891.*

486-50MHz.

50MHz Price Barrier!

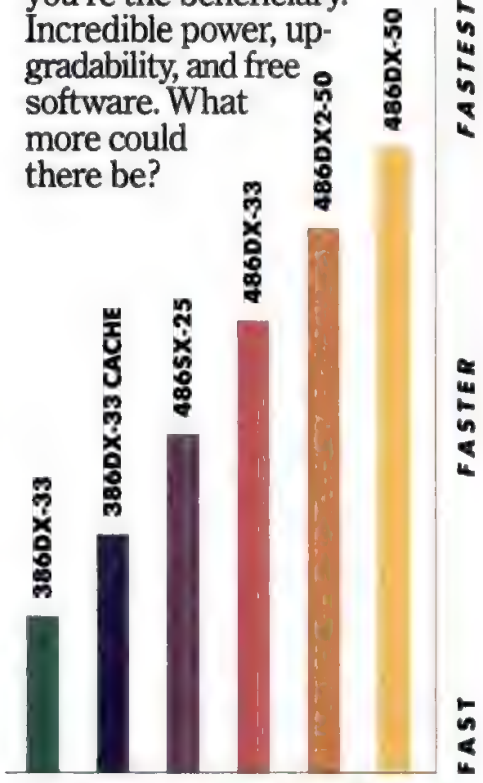
Pick Your Power!

Or Customize, Customize, Customize! Just Tell Us and We'll Do It.

Now, ZEOS lets you pick exactly the power you want for the price you want to pay. Simply match the processor with the package configuration and you have your price. Or if you wish, we will custom build any system to your exact specifications.

And don't forget, with every ZEOS Windows System (packages 2, 3 and 4) you'll also receive your choice of 2 out of 3: *Lotus 1-2-3 for Windows, Ami Pro 2.0,* and *Freelance Graphics.* The Lotus software alone carries a suggested retail of over $1,000 and even street prices are over $700. Yet we're giving it to you at *no additional charge!* That's ZEOS value.

No doubt about it. ZEOS has broken the price/performance barrier with these great new upgradables, and you're the beneficiary. Incredible power, upgradability, and free software. What more could there be?



Z•SPEED GRAPHOMETER

Let the "Z-Graphometer" help you pick the processing power that's right for you. The comparisons are easy to make. Fast, Faster and Fastest!

ZEOS COMPLETE SYSTEM PACKAGE #1

- The processor and speed of your choice plus future upgradability!
- 1MB of high-speed RAM, expandable to a system total of 32MB right on the motherboard.
- 42MB high-speed IDE hard drive with its own cache.
- 1.2MB or 1.44MB Teac® floppy drive.
- ZEOS 14" flat screen Hi-Res amber monitor with Tilt/Swivel Base.
- Shadow RAM and EMS support for enhanced performance.
- ZEOS/RS 101-key SpaceSaver keyboard.
- Two serial, one parallel & one game port built right onto the motherboard.
- 7-16, 1-8 bit expansion slots. 80387 math co-processor support for '386 systems.
- Rugged ZEOS SpaceSaver case with twin cooling fans for added reliability and product life.
- Seven drive bays and our high-capacity power supply with built-in surge suppressor!
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support and Customer Satisfaction package.

INCREDIBLE ZEOS PACKAGE #2

We take Package #1 and upgrade your ZEOS Modular System to include:

- 2 full Megabytes of rip-roaring RAM.
- Our incredible 107MB IDE hard drive with its own built-in cache.
- Both the Teac® 1.2MB and 1.44MB floppy drives.
- Diamond Stealth VGA card/1MB RAM & Sierra DAC plus WinRIX drawing software!
- ZEOS 14" High-Res VGA mono monitor with Tilt & Swivel Base.
- Microsoft Mouse, Microsoft Windows and DOS, plus 2 out of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro 2.0, and Freelance Graphics!

ore Power.

ZEOS ANNOUNCES: BUILT-IN SURGE SUPPRESSION!

Right now, ZEOS is proud to announce that we've taken our top-of-the-line high-capacity supply and added a *built-in surge suppressor.* Building the surge suppressor right into the power supply increases reliability and helps protect your investment. We wonder how long it will take for the rest of the industry to catch up. And while ZEOS is giving you critically important features like these, we add yet another.

UL® Listing! As *PC Magazine* said, UL Listing is "one of the few forms of peace of mind you can buy." Every ZEOS system is Underwriters Laboratories Listed. This means your entire system (not just the power supply) has met the stringent safety requirements of Underwriters Laboratories. Not only that, but your ZEOS UL listing says a lot about quality too. UL safety listings are something many of our competitors simply don't (or can't) provide you. At ZEOS, quality and safety are important to us. *You are important to us!*

Prices. ded!

Now pick two Windows applications from Lotus!

24-HOUR-A-DAY TOLL-FREE TECHNICAL SUPPORT.

The importance of having you as a customer shows in many other ways as well. For example, at ZEOS we believe supporting *you* should be more than a part-time proposition. As *PC Magazine* said, "Insist on a good service and support package. Expect…24-hour seven-day-a-week support." We've been saying that for years. In fact, it was ZEOS that invented *24-Hour-a-Day Toll-Free Sales and Technical Support.* Our customers tell us they love it. And you will too. Any time you need assistance, a ZEOS technician is only a phone call away.

Price, Performance. Quality and Support. There are *many* reasons to buy your new ZEOS system. All of them backed by your ZEOS Customer Satisfaction Package which includes our 30-Day Money-Back Guarantee, One Full Year Limited Warranty and Express Parts Replacement Policy. How do you get one?

ORDERING IS EASY!

Ordering your new ZEOS system is indeed easy. Simply pick the Power and Package you want or let us custom build your new system to your exact specifications! Whatever you decide, a friendly and knowledgeable ZEOS Systems Consultant is waiting to assist you. And whatever you select, one thing is for certain.

Buying your new ZEOS system is perhaps the best purchase decision you'll ever make. So why not give us a call right now. You're going to be very satisfied. We don't just say it. We guarantee it! *Call Now Toll Free, 800-423-5891.*

ZEOS. Mo

ANNOUNCING THREE HOT NEW PROCESSOR OPTIONS: 486SX-25, 486DX2-50 AND 486DX-50!

Go ahead and Pick your Power! ZEOS gives you all the options. You can start out by taking a look at the de facto desktop power standard, the 386DX-33. Our '386-33 workhorse is a great entry point for true desktop power computing. But if it's a '486 you're after, hang on to your hat!

Because you're off to a fast start with our brand new 486SX-25. The 486SX is like a 486DX without the built-in math coprocessor. It's the easiest way to own the '486. And for full-blown 486*DX* power, why not opt for your own *Editors' Choice* system!

It's the ZEOS Editors' Choice 486DX-33. Quite simply, there is nothing else like it. Go with the ZEOS '486 if you want the type of quality, performance and value that makes an *Editors' Choice* machine. And if it's *50MHz* you've been dreaming about, dream no more.

Because right here, right now, ZEOS gives you the option of '486 50MHz power! We're talking power unlike anything you've seen before. Take either the ZEOS 486DX2-50 or the 486DX-50. Absolutely unbelievable *performance!* And the price? That's what you really won't believe; only a couple hundred dollars more than the ZEOS 486-33. *Amazing.*

AND THAT'S JUST FOR STARTERS.

Because ZEOS combines the high-speed upgradable processor of your choice with some of the fastest DRAM made. Both are mounted on your ZEOS system board, one of the most advanced in the industry. And that's where your new system really begins to shine.

Because to this we add an *incredibly fast* IDE hard drive and genuine Teac® floppy drives. We have located the ports for these drives right on the motherboard along with your serial, parallel and game ports. The result? Two slots are saved, giving your new ZEOS system a total of *seven.* All this while others are trying to get you to accept fewer slots. It's part of your ZEOS expansion advantage. The slots to expand, how about the room?

This is where ZEOS has performed something akin to magic. We call it our SpaceSaver case. Complete with *seven* drive bays, this incredible case is actually smaller than many cases offering only five drive bays. Plus, we've also added a *second whisper-quiet cooling fan.* Why? Because the cooler a system runs the longer it will last.

Now that's ZEOS Value. Speaking of which, here's another industry first you will definitely benefit from.

Great Load

From ZEOS, lots more.

Because your new ZEOS system is not only fast, it's absolutely loaded with features. Like our high-capacity power supply with *built-in surge suppression,* eight expansion slots, twin cooling fans for even more reliability, plus our unique seven-bay Space-Saver case. And, every ZEOS system is UL® listed.

And don't forget you're also receiving 24-Hour-a-Day Toll-Free Technical Support, our 30-day Absolute Satisfaction Money-Back Guarantee, Express Parts Replacement and more. So go ahead.

Pick your Power, your Package, and your Price and give us a call. Your friendly, expert ZEOS Systems Consultant is ready to answer any questions you may have! *Call Now Toll Free 800-423-5891.*

NEW LOWER PRICES!

PACKAGES 2, 3 AND 4 INCLUDE LOTUS BUNDLE!

	Pkg. #1	Pkg. #2	Pkg. #3	Pkg. #4
386DX-33	$1295	$1795	$2295	$2695
486SX-25	$1395	$1895	$2395	$2795
486DX-33	$1595	$2095	$2595	$2995
486DX2-50	$1795	$2295	$2795	$3195
486DX-50	$1995	$2495	$2995	$3395

Add $200 to any price for a 128K cache.

PICK YOUR PAYMENT OPTION TOO:

When you buy from ZEOS you have a wide variety of payment options. We accept MasterCard, VISA, American Express and Discover cards, or if you wish we can ship COD.

We also have our own ZEOS credit card, the Z-Card.℠ The Z-Card allows you to charge your ZEOS purchases just like a MasterCard or VISA. There is a low consumer rate and there is no annual fee. We can send you an application or you can apply right over the phone. Our special toll-free application number is 800-421-8942.

ZEOS also offers a terrific leasing program for businesses. The rates are lower than those charged by most of the others in our industry. We will promptly mail or fax you an application on request. Just give us a call at 800-423-5891.

Purchase orders from Fortune 1000 companies, governments and institutions are subject to credit approval. Wire transfer is also available. Please call 800-423-5891 for details.

INCREDIBLE ZEOS PACKAGE #3

Add even more memory, a larger drive. And more savings! You now receive:

- **4 full Megabytes of ultra-high-speed RAM.**
- **Our fast 130MB IDE hard drive with built-in cache.**
- **Teac® 1.2 & 1.44MB FDD's!**
- **Diamond Stealth VGA card/1MB RAM (32,000+ colors) plus WinRIX drawing software!**
- **ZEOS 14" 1024x768 non-interlaced VGA Color monitor w/Tilt & Swivel.**
- **Microsoft Mouse, Microsoft Windows and DOS, plus 2 out of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro 2.0, and Freelance Graphics!**

THE ULTIMATE ZEOS PACKAGE #4

Now, memory goes to 8MB and the drive to 210MB. *PC Magazine Editors' Choice* configuration!

- **8 full Megabytes of high-speed RAM.**
- **Your screaming 210MB IDE hard drive with its own built-in cache.**
- **Teac® 1.2 & 1.44MB FDD's!**
- **Diamond Stealth VGA card/1MB RAM (32,000+ colors) plus WinRIX drawing software!**
- **ZEOS 14" 1024x768 non-interlaced VGA Color monitor w/Tilt & Swivel.**
- **Microsoft Mouse, Microsoft Windows and DOS, plus 2 out of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro 2.0, and Freelance Graphics!**

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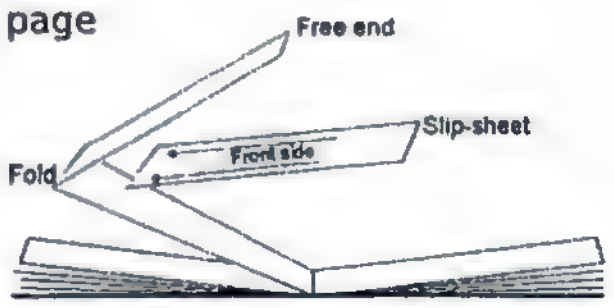
GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side

GbsSlipBack-0018

Back

1. Follow instructions on the other side

If you thought power like this was out of your budget, take another look. While many of the others don't even offer 50MHz power, *you can own the new ZEOS 486DX2-50 starting complete for as low as $1795, or the full-blown 486DX-50 for as low as $1995!*

Select from any of four money-saving packages. Or, if you wish, let us custom-build your hot new 486-50 to your exact specifications.

ZEOS POWER GRID FOR THE 486DX2-50

Apply The "Zeos Power Grid" To Match Your 50MHz Needs. Add $200 for 128K cache. Prices shown are for Intel 486DX2-50 CPU; for 486DX-50 add $200.

	Intel 80486DX2-50MHz	Upgradable CPU	1MB High-Speed RAM	2MB High-Speed RAM	4MB High-Speed RAM	8MB High-Speed RAM	42MB HDD, Fast IDE	107MB HDD, Fast IDE	130MB HDD, Fast IDE	210MB HDD, Fast IDE	Teac® 1.2 Floppy Drive	Teac® 1.44 Floppy Drive	14" Hi-Res TTL Monitor	14" VGA Mono Monitor	14" VGA Color 1024 x 768 NI	Monitor Tilt & Swivel	Hercules® Graphics Card	Hi-Color VGA Card, 1MB	Sierra DAC	Shadow RAM/EMS Support	ZEOS/RS 101 keyboard	7-16, 1-8 bit exp	Hi
Pkg. #1 Only $1795	■	■	■				■				■		■			■	■			■	■	■	■
Pkg. #2 Only $2295	■	■		■				■			■	■		■		■		■	■	■	■	■	■
Pkg. #3 Only $2795	■	■			■				■		■	■			■	■		■	■	■	■	■	■
Pkg. #4 Only $3195	■	■				■				■	■	■			■	■		■	■	■	■	■	■

WHAT SHOULD I GET?

How should you configure your new ZEOS 486-50? Of course the best answer depends on your needs and what you plan to use your new system for. But never before has so much power been available to everyone at such a low price. Our suggestion would be to consider investing in two areas when you buy your new 50MHz system. The memory and drives. Particularly the memory.

From what we're hearing, memory will be important with the new operating systems debuting later this year. We would strongly recommend at least 4 megabytes, eight if it's in the budget. As for drives, think in terms of 100+ megabytes; applications just don't seem to be shrinking (however, before you go too wild, remember you can always add more drives). Both of our

Your Own '4

ZEOS Breaks the '486-

Computers Now!SM

Take Your Pick. We'll Ship Today!

ORDER BY 1 O'CLOCK GUARANTEED! WE'LL SHIP TODAY

RIGHT NOW. GUARANTEED!* *Yes,* we can ship your new ZEOS '386 or '486 today! We've built up an extra supply of the hottest selling computers in America in their most popular configurations.

Here's how it works. We have these incredible ZEOS '386 and '486 color VGA systems pre-built and ready to ship. While supplies last, we will ship any of these systems to you *the day you order* subject to these conditions:

1. Your order must be received by 1PM Central Time M-F.
2. Credit Cards are subject to authorization.
3. Orders must be for ZEOS '386 or '486 systems configured as shown here. Any other systems or upgrades are custom-built and will take slightly longer.

***OUR GUARANTEE TO YOU:**
If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it at *our expense* as soon as it is ready.

This offer is good only as long as these pre-built systems remain in stock; please give us a call to verify availability. This offer does not apply to other ZEOS systems or custom configurations.

IMMEDIATE SHIPMENT IS ONLY PART OF THE STORY.

These are not just any computer systems. They're the high performance, high quality ZEOS *upgradable* systems. Packing all the ZEOS value that has won PC Magazine Editors' Choice– *nine times!*

So why not give us a call right now. If we hear from you by 1:00 this afternoon, we'll get your new system on the way to you today! Call now Toll Free 800-423-5891.

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Our most popular '386 & '486 packages! 128K Cache, 130MB Drive, 4MB Memory and More. Ready to ship today!

386-33 ONLY $2495. As a 486-33 ONLY $2795!

- Upgradable CPU module allows you to change processors as your computing needs change!
- Ultra-high-speed zero-wait 128K SRAM cache.
- 4MB of zero-wait DRAM, expandable to a total of 32MB on the motherboard.
- Ultra-fast 130MB IDE hard drive.
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- Microsoft Mouse, Microsoft Windows and DOS, plus 2 out of 3 Windows applications: Lotus 1-2-3, Ami Pro 2.0, and Freelance Graphics!
- Shadow RAM and EMS support for enhanced performance.
- ZEOS/RS 101-key SpaceSaver keyboard.
- High-speed ZEOS I/O with two serial, one parallel & one game port built in.
- 7-16, 1-8 bit expansion slots. Math coprocessor support for '386.
- Rugged ZEOS SpaceSaver case with two cooling fans for added reliability and product life.
- Seven drive bays and our high-capacity power supply now with its own built-in surge suppressor.
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support and Customer Satisfaction package.

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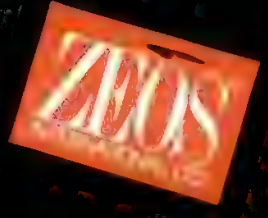

▶ SUMMARY OF FEATURES

Color Portables

List price (tested configuration) *PC Magazine* usually compares the prices of similarly equipped machines, but the configurations for these color portables defy standardization. We therefore provide the price of each system as delivered to *PC Magazine* and tested by PC Magazine Labs

The tested configurations of all the systems in this section include DOS 5.0. Some vendors also bundle Microsoft Windows 3.1 with their systems.

Distribution channel Some machines are sold directly through mail order, others through dealers. Dealers have previously offered discounts of 25 percent or more off the list price; however, an industry-wide price restructuring has cut these discounts in many cases. *PC Magazine* views a 15 percent discount as typical.

Weight/travel weight Each notebook's weight includes the weight of the battery. The travel weight adds that of the AC adapter brick and power cord. For AC-powered systems without batteries, we report only one weight, which includes the power cord.

Keys: total, function, cursor The table describes each color portable's built-in keyboard: the total number of keys, the number of function keys (10 or 12), and the number of cursor keys (0, 4, or 8). If you have only 4 cursor keys and you need to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys—an inconvenient extra step

Motherboard manufacturer Some machines are based on motherboards made by major manufacturers, although their other components may vary

The **chip set manufacturer** makes the logic connecting the CPU with the other functions managed by the system board.

The **BIOS version (or date)** can affect PC Magazine Labs' benchmark test results. A machine with another BIOS may perform differently.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced performance speed. Shadowing uses RAM located between 640K and 1MB

Proprietary expansion port Some machines have an expansion port that lets you connect the system bus to an external device, such as an expansion station or external floppy disk drive.

Expansion slots refers to standard-type expansion slots that accommodate ISA or EISA add-in cards, and in this case do not include internal modem or memory slots. All the systems included here support an internal modem. Company-provided modem options are listed later in this table

An **expansion unit,** also called a docking station or expansion station, provides additional space for standard expansion cards and hard disks, tape drives, and floppy disk drives.

Screen manufacturer Most vendors purchase liquid crystal displays from outside sources.

The **video chip set manufacturer** makes the logic that drives the LCD screen and any external monitor hookup. The chip set and video memory determine the **maximum external resolution** and number of simultaneous colors the external monitor can display.

Maximum external colors Lowering an external monitor's resolution usually increases the number of colors it can display

Internal modem options describes the functions and compression schemes of the vendor's modem options. Unless otherwise noted, data modems run at 2,400 bits per second and fax modems at 9,600 bps. A 9,600-bps fax modem has send-and-receive fax capabilities at 9,600 bps and also has 2,400-bps data-modem capability. We also identify send-only fax modems. Such fast modems benefit from built-in data compression and error correction. *MNP 5 compression* is the most widespread form of data compression in use and includes MNP 2 through MNP 4 error control. *V.42 error control* is an emerging standard, as is *V.42bis compression*, which includes V.42 error control and MNP 5 compression. Whenever possible, you should consider MNP 5 compression as a minimum requirement.

The **AC adapter size** can vary significantly among machines with similar power needs

The **rated battery life** is the vendor's rating for the internal battery or batteries. PC Magazine Labs independently tests the battery life and reports the results of our Battery Rundown and ZDigit Rundown tests. The ZDigit test lets each notebook use its power-conservation features, while the Battery Rundown test gives a worst-case result. We also indicate the battery **charge time** with the unit on and off, as reported by the vendors

The **battery weight, amp/hour rating** shows the battery's weight in pounds, as well as how long that battery is rated to deliver a current of 1 ampere per hour. You'll notice a wide discrepancy among battery sizes and power ratings in this issue

The battery-powered systems in this review all include power-conservation features, such as **automatic display** dimming or blanking, automatic **hard disk power-down** (a common feature), slowing or halting the **CPU,** and removing power from **peripherals** such as I/O ports (modem and serial ports) when the machine is not in use. More advanced power-management features include **standby** mode, whereby a system preserves its current state in memory, via a secondary battery in most cases, and **hibernation,** in which the system's state is written to the hard disk. The latter ensures that the system never loses its information when battery power fails.

All systems in this section include at least a one-year parts-and-labor warranty; Dolch extends that coverage a second year for labor only. See the individual reviews for each vendor's support policies

Furthermore, every system was certified by the Federal Communications Commission with a Class B rating. This shows that an electronic device has sufficiently low radio-frequency emissions to be used in the home. Portable PCs must have a Class B certification. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072

CONTINUES

▶ SUMMARY OF FEATURES

Color Portables

Companies listed in alphabetical order

■ = YES □ = NO

	AST Premium Exec 386SX/25C	Compaq Portable 486C (PC Editor's Choice)	Dell System 325NC	Dolch P.A.C. 486-50E	Dolch P.A.C. 486-33E
List price (tested configuration)	$3,595	$9,017	$4,047	$16,937	$15,442
Processor type and speed	AMD Am386SXL/25	Intel 486DX/33	Intel 386SL/25	Intel 486DX/50	Intel 486DX/33
Hard disk capacity	80MB	120MB	84MB	420MB	420MB
Microsoft Windows 3.1	■	□	■	□	□
Distribution channel	Dealers	Dealers	Direct	Dealers	Dealers
Dimensions (HWD, in inches)	2.5 x 11.5 x 9	5.5 x 15.6 x 11	2.5 x 11 x 8.5	9.5 x 15.5 x 8.5	9.5 x 15.5 x 8.5
Weight/travel weight (pounds)	7.5, 8.7	17	7.3, 8.6	21.1	20.5
Display area (H x W, in inches)	5.3 x 7.3	6.5 x 8.5	5.6 x 7.4	6.5 x 8.5	6.5 x 8.5
Keys: total, function, cursor	82, 10, 8	101, 12, 4	85, 12, 4	86, 12, 4	86, 12, 4
Motherboard manufacturer	AST	Compaq	Dell	AIR	AIR
Chip set manufacturer	WD	Compaq	Intel	Intel	Intel
BIOS version (or date)	AST 2.00	Compaq 386E3	Phoenix 1.01A	Phoenix 1.01	Phoenix 1.01
Setup in ROM/Password in ROM	■ ■	■ ■	■ ■	■ □	■ □
System shadowing/Video shadowing	■ ■	■ ■	■ ■	□ ■	■ ■
Memory and Disk Drives					
Installable RAM	4MB–8MB	2MB–32MB	4MB–12MB	4MB–32MB	4MB–32MB
User-installable	■	■	■	□	□
External processor RAM cache	None	None	64K	128K	128K
Available hard disk sizes	60MB, 80MB, 120MB	120MB, 210MB	60MB, 84MB	120MB, 240MB, 420MB	120MB, 240MB, 420MB
I/O and Expansion					
Parallel, serial, mouse ports	1, 1, 0	1, 1, 1	1, 1, 1	1, 1, 0	1, 1, 0
Proprietary expansion port	□	■	□	□	□
Expansion slots	None	2 32-bit EISA	None	6 32-bit EISA	6 32-bit EISA
Expansion unit	□	□	□	□	□
Video					
Screen manufacturer	Sanyo	Sharp	Sharp	Hitachi	Hitachi
Type of display	Passive	Active	Passive	Active	Active
Maximum simultaneous colors	16	256	16	256	256
Video chip set manufacturer	Cirrus	Compaq	WD	C&T	C&T
Simultaneous external display	■	■	□	■	■
Maximum external resolution	800 x 600 x 16	640 x 480 x 256	800 x 600 x 16	800 x 600 x 16	800 x 600 x 16
Maximum external colors	16	256	256	65,000	65,000
Modem					
Internal modem options	2,400-bps ($249), 9,600-bps fax ($499), 9,600-bps send-fax ($349)	2,400-bps ($319)	9,600-bps: fax ($149), fax with MNP 5 ($299), data/fax ($599)	2,400-bps ($124)	2,400-bps ($124)
AC Adapter and Battery					
AC adapter size (inches)	5.5 x 2.3 x 1.5	N/A	2 x 5.5 x 3.1	N/A	N/A
Rated battery life (hours)	2	N/A	3	N/A	N/A
ZDigit, Battery Rundown test scores (hours:minutes)	2:31, 2:12	N/A	4:59, 2:53	N/A	N/A
Charge time while on, off (hours)	3, 3	N/A	8, 3.5	N/A	N/A
Battery weight, amp/hour rating	0.9 lbs, 5.7Ah	N/A	1.6 lbs, 2.2Ah	N/A	N/A
Display/hard disk power-down	■ ■	N/A	■ ■	N/A	N/A
CPU/peripherals power-down	■ ■	N/A	■ ■	N/A	N/A
Standby/Hibernation	■ □	N/A	■ ■	N/A	N/A

* The travel weight of the Micronics MPort 450 includes the 3 8-pound Color Mpression display panel. N/A—Not applicable: This product uses AC only

AIR—Advanced Integration Research, AST—AST Research Inc., C&T—Chips & Technologies Inc., DTI—Display Technologies Inc., UMC—United Microelectronics Corp., WD—Western Digital

Dolch P.A.C. 386-33C	IBM PS/2 Model CL57SX	Micronics Mport 450	NEC ProSpeed 486SX/C	NEC UltraLite SL/25C	Toshiba T6400DXC	Toshiba T6400SXC	Toshiba T4400SXC (PC Editors' Choice)
$12,511	$6,410	$12,795	$8,099	$5,999	$9,948	$8,648	$7,699
Intel 386DX/33	Intel 386SX/20	Intel 486DX2/50	Intel 486SX/20	Intel 386SL/25	Intel 486DX/33	Intel 486SX/25	Intel 486SX/25
420MB	80MB	230MB	120MB	80MB	200MB	120MB	85MB
☐	☐	■	■	■	☐	☐	☐
Dealers	Dealers	Dealers	Dealers	Dealers	Dealers	Dealers	Dealers
9.5 x 15.5 x 8.5	3 x 13 x 11	4 x 16 x 12.3	4.3 x 15.5 x 14.8	2.5 x 11.5 x 9.5	4.5 x 15.5 x 10.5	4.5 x 15.5 x 10.5	2 x 8 x 11.5
19.5	11.4, 13.7	14.6, 18.4 *	17.8	7.2, 8.8	13.3	13.3	7.8, 9.5
6.5 x 8.5	6.5 x 8.5	6 x 8	6.5 x 8.5	6 x 7.5	6.5 x 8.5	6.5 x 8.5	6 x 7.5
86, 12, 4	84, 12, 4	82, 10, 0	91, 12, 4	78, 12, 4	101, 12, 8	101, 12, 8	82, 12, 8
Dolch	IBM	Micronics	NEC	NEC	Toshiba	Toshiba	Toshiba
UMC	IBM	C&T	Intel	Intel	Toshiba	Toshiba	Toshiba
AMI (July 1991)	IBM (Feb. 1992)	Phoenix 0.10 P18	Phoenix E486SX 1.0	Phoenix 386SL 1.0	Toshiba 1.30	Toshiba 1.30	Toshiba 3/06E92
☐■	■■	■☐	☐■	■■	☐■	☐■	■■
■■	☐■	■■	■■	■■	■☐	■☐	■☐
4MB–32MB	2MB–16MB	0–32MB	2MB–20MB	2MB–10MB	4MB–20MB	4MB–20MB	4MB–20MB
☐	■	■	■	☐	■	■	■
64K	None	None	None	64K	None	None	None
120MB, 240MB, 420MB	80MB	120MB, 230MB	120MB, 240MB	80MB, 120MB	120MB, 200MB	120MB, 200MB	85MB, 120MB
1, 1, 0	1, 1, 0	1, 2, 0	1, 1, 2	1, 1, 1	1, 1, 1	1, 1, 1	1, 1, 1
☐	■	☐	■	■	■	■	■
6 16-bit ISA	None	1 16-bit ISA	1 32-bit EISA	None	1 16-bit, 1 8-bit ISA	1 16-bit, 1 8-bit ISA	None
☐	☐	☐	☐	$899	☐	☐	$999
Hitachi	DTI	Sharp	Hitachi	NEC	Sharp/DTI	Sharp/DTI	Sharp
Active	Active	Active	Active	Active	Active	Active	Active
256	256	256	256	16	256	256	256
C&T	IBM	Cirrus	WD	Cirrus	WD	WD	WD
■	■	■	■	■	☐	☐	■
800 x 600 x 16	640 x 480 x 256	800 x 600 x 16	1,024 x 768 x 16	800 x 600 x 16	640 x 480 x 256	640 x 480 x 256	640 x 480 x 256
65,000	4,096	256	256	256	180,000	180,000	256
2,400-bps ($124)	9,600-bps fax ($365)	None	2,400-bps ($299), 9,600-bps fax ($499)	2,400-bps ($299), 9,600-bps fax ($499)	2,400-bps ($199), 2,400-bps V.42bis ($259), 9,600-bps data/fax ($699)	2,400-bps ($199), 2,400-bps V.42bis ($259), 9,600-bps data/fax ($699)	2,400-bps ($199), 2,400-bps V.42bis ($259), 9,600-bps data/fax ($699)
N/A	3.5 x 8 x 2	N/A	N/A	2 x 2.5 x 8	N/A	N/A	6 x 3 x 2
N/A	1	N/A	N/A	1	N/A	N/A	3
N/A	1:09, 0:50	N/A	N/A	2:17, 1:11	N/A	N/A	4:05, 2:26
N/A	2, 1	N/A	N/A	15, 3	N/A	N/A	4, 1.5
N/A	0.8 lbs, 1.4Ah	N/A	N/A	1lb, 1.7Ah	N/A	N/A	2.3 lbs, 2.4Ah
N/A	■■	N/A	N/A	■■	N/A	N/A	■■
N/A	■■	N/A	N/A	■■	N/A	N/A	■■
N/A	■■	N/A	N/A	■■	N/A	N/A	■☐

ENDS

way, remaining competitive throughout. Its active-matrix color VGA screen was among the best we've seen. Toshiba receives its 10.4-inch color panels from two sources: Display Technologies, the Toshiba-IBM (Japan) joint venture, and Sharp Electronics. Combined with a Western Digital video chip set, this notebook proved to be among the fastest video performers. The T6400DXC's 200MB Conner CP-30204 hard disk also proved to be very fast, while its 120MB sibling, the T6400SXC, turned in a respectable score.

Toshiba sells the T6400 series through the dealer channel, so look for discounts where you shop. Extras include a $259 internal 2,400-bps V.42bis modem and a plastic or leather carrying case.

TOSHIBA T4400SXC

The Toshiba T4400SXC is small and light, and it has great color. Virtually identical to the 486 monochrome T4400SX reviewed earlier, in "Fitting the World Inside Your Briefcase" (with one colorful difference), the $7,699 active-matrix T4400SXC offers the same superior performance, design, and construction but adds an exceptional display as well.

The stir that this 25-MHz 486 caused on our video tests was due to more than just the outstanding quality of its active-matrix color display. Its Western Digital WD90C30 video chip set with 512K of video RAM placed second to the Compaq Portable 486C on our video and Graphics Winmark tests. And it's not just pretty; it's also fast.

Our one complaint was that the T4400SXC's 8.5-inch screen is about an inch smaller diagonally than that of its monochrome counterparts. Its other test scores were similar to those of the monochrome portables, with one exception. Active-matrix color plus the high-performance video chip set combined to decrease the life of the T4400SXC's nickel cadmium battery to 2 hours 21 minutes—some 27 minutes shorter than the monochrome T4400SX. The T4400SXC has the same power-conservation features as the monochrome version and supports the same options its monochrome siblings do.

To back up its line of portables, Toshiba covers all its systems with a one-year warranty on parts and labor and supplies toll-free technical support.—*Oliver Rist* □

THE COMPLETED PC

The Power Behind Notebook Accessories

While using a notebook PC often involves trade-offs, the right accessories can transform your notebook into a no-compromise computer.

by Jeff Greenberg

The most frequent reason for buying a portable is to have computing capability on the road. But to yield any real benefit, it is usually necessary to transform a portable computer into your own personal portable computing system by adding accessories and upgrades. To help in this process, we've put together a brief guide to products that help make your notebook a more efficient tool. Many companies provide similar products, however, and we regret that we cannot mention them all. What follows should give you some good ideas on where to begin your search for the right accessories.

KEEPING IN TOUCH

While traveling, mobile professionals need to communicate with the rest of the world. A wide variety of modems are available to accomplish this (for a review of portable modems, see "Portable and Fast: Sizzling Modems to Go" in this issue's Communications feature). However, a standard modem is not always enough.

Not all telephones are cooperative enough to offer a modular RJ-11 telephone connector. To use a modem in these situations, Unlimited Systems Corp. (San Diego, California; 800-275-6354, 619-277-3300) offers Konexx handset adapters ($99 to $149). These devices are placed between the telephone base and the handset. In cases where the handset cannot be unplugged from the base, alligator clips and instructions enable the user to wire the Konexx directly to the handset electronics.

If a handset adapter is not a feasible option, an acoustic coupler may be what you need. Unlimited Systems also offers the $149 Konexx Koupler (reviewed in New & Improved, February 11, 1992). Information Machines (Woodland Hills, California; 818-884-5779) makes an acoustic coupler, the $179 MA-100, which straps to a telephone handset. This product works with any modem (including fax modems) and can transmit at speeds up to 9,600 bits per second on telephones equipped with electronic microphones. Even on older phones with carbon microphones, you can expect 2,400-bps speeds.

For the traveler who wants to be prepared for any potential communications problems, Computer Products Plus offers the Road Warrior Toolkit (Huntington Beach, California; 800-274-4277, 714-847-1799). The kit includes a handset adapter, an acoustic coupler, an RJ-11 Y connector, and tools, all in a convenient carrying case. At $279.95, it isn't cheap, but the company also offers a basic set of tools for $49.95; additional tools and different combinations of tools are also available.

If you won't have access to a telephone, you might consider a cellular or radio modem. Spectrum Information Technologies (Dallas, Texas; 214-630-

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Picture Windows

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- COLOR CALIBRATION SYSTEM
- LOW EMISSION DESIGN

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The auto-scanning, high-resolution Diamond Pro 17 has a vertically flat, square-cornered CRT and features Mitsubishi's DigiCon™ digital convergence control and the Diamond Match Color Calibration System for color-critical applications. It's compatible with all medium- and high-resolution graphics standards from VGA through 1280 x 1024 at 60 Hz non-interlaced as well as the popular flicker-free 1024 x 768 high refresh rates up to 76 Hz non-interlaced.

For more information, call Mitsubishi Electronics at 1-800-843-2515. In Canada, call 1-800-387-9630 or in Mexico 91-800-83456.

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INFORMATION SYSTEMS DIVISION

Mitsubishi Electronics America, Inc., Information Systems Division, 5665 Plaza Drive, Cypress, CA 90630.
Mitsubishi Electric Sales Canada, Inc., 4299 14th Avenue, Markham, Ontario L3R 0J2.

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Actual unretouched screen image produced from Modern Medium Inc. (*RenderStar 2*).

CIRCLE 280 ON READER SERVICE CARD

9825) manufactures a line of adapters that enable standard modems to communicate via a cellular phone. Each adapter works with a few different cellular phone models, and new models are being released every month. For applications that require one-way transmission, Skytel (Washington, D.C.; 800-527-3508, 202-408-7444) offers the $399 pager, Skystream, which can download alphanumeric messages transmitted through a serial port.

Triton Technologies' CO/Session, Microcom's Carbon Copy Plus

The type of communications you will be using determines what you will need in addition to a modem. File transfer, the simplest type of communications, can be accomplished with a modem communications package such as Crosstalk (Digital Communications Associates, Alpharetta, Georgia; 800-348-3221, 404-442-4000), and Procomm (Datastorm Technologies, Columbia, Missouri; 314-443-3282).

For more complex data transactions with the home office, a remote operating environment may be required. For instance, the portable computer is configured to behave as a remote screen and keyboard for the host desktop computer. Any task that can be done on the desktop can now be done remotely on your portable. Here are some of the most popular remote-LAN access packages: the $199 Carbon Copy Plus (Microcom, Norwood, Massachusetts; 800-822-8224, 617-551-1000), $195 CO/Session (Triton Technologies, Iselin, New Jersey; 800-322-9440, 908-855-9440), and $179 Norton pcAnywhere (Symantec/Peter Norton Group, Cupertino, California; 800-441-7234, 408-253-9600).

An alternative method that doesn't require a dedicated PC back at the office is to use the $1,699 Shiva NetModem/E (Shiva Corp., Cambridge, Massachusetts; 800-458-3550, 617-252-6300). This device combines an Ethernet network controller with a V.32bis modem capable of speeds up to 57.6 kilobits per second. NetModem/E allows the remote user to compute as if connected directly to the network, but at a slower access speed.

FINDING MORE ROOM FOR STORAGE

Despite recent advances in 2.5- and 3.5-inch disk technology, many portable users still find they need more storage capacity. Luckily, there is a wide variety of portable storage devices to augment the limited capacity of today's portable computers. Most of these devices communicate with the portable computer through the parallel port, resulting in slower but usually acceptable performance.

Disctec (Winter Park, Florida; 800-553-0337, 407-671-5500) manufactures battery-powered external hard disks with removable disk cartridges ($295 to $1,145). These cartridges are available in capacities up to 120MB with average seek times of 19 to 21 milliseconds. In addition, Disctec offers a line of battery-powered nonremovable hard disks with capacities up to 120MB.

Stac Electronics' Stacker

BSE Co. takes a somewhat different approach (Flagstaff, Arizona; 602-527-8843). BSE manufactures external hard disk enclosures. An AC-powered enclosure can house any available 3.5-inch hard disk, and a battery-powered enclosure can house any 2.5-inch unit. Costing $199 each, the products let you make a portable storage system out of the latest available hard disk technology.

Other manufacturers that offer portable hard disks include Simplicity Computing (New York, New York; 800-275-6525, 212-229-1625) and Sysgen (located in Milipitas, California; 800-821-2151, 408-263-4411).

One possible alternative to hard disks is the $1,149 Bernoulli Transportable 90 portable hard disk (Iomega Corp., Roy, Utah; 800-456-5522, 801-778-1000). Used in conjunction with the Bernoulli Parallel Port Interface, this product gives the mobile user a high-speed hard disk that can store up to 90MB on a removable cartridge.

If you don't want to carry an external hard disk or purchase an internal upgrade, you might consider data-compression software. Packages like the $47 PKZIP (PKWare, Brown Deer, Wisconsin; 414-354-8699), and LHA, a Japanese compression program that's also a *PC Magazine* Editors' Choice winner ("Squeeze Play," October 15, 1991), compress files for storage and transmission. Both are shareware and can be downloaded from Section 16 (Gen Utils Library) of the Utilities/Tips Forum on PC MagNet. While still effective, these packages require the user to decompress each file manually before use.

A new generation of compression software that eliminates the need for manual intervention has recently become available. Companies such as Stac Electronics (Carlsbad, California; 800-522-7822, 619-431-7474) and AddStor (Menlo Park, California; 800-732-3133, 415-688-0470) now produce software (Stacker and SuperStor, respectively) that performs transparently, automatically compressing files as they're written to disk and decompressing them as they're read ("Double—No—Triple Your Hard Disk Space With On-the-Fly Data Compression Utilities," January 28, 1992).

For some people, extra disk space is not necessary, and a portable tape drive will suffice. QuanTech International

Now Windows is as easy to use as DOS.

Microsoft® Windows® is capable of great and wonderful things.

But if you're among the many who've traded the frustration of the C: prompt for the graphical confusion of Program Manager, relax.

You're about to discover what half a million delighted DOS® and network users already know.

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It's the world's best-selling menuing software. And as soon as you install it you'll understand why.

Direct Access searches your disk, gathers your programs into logical groups and builds menu screens just like the one you see at the top of this page.

All by itself.

That's right. You just load it and forget it.

Whenever you want an application, all you have to do is hit one key.

Or, if you prefer, click one mouse.

The more applications you have on your disk, the more you'll delight in Direct Access.

That's because Program Manager insists on grouping your programs into five arbitrary categories: "Windows Applications," "Non-Windows Applications," "Accessories," "Games" and "Main."

Not very intuitive, eh?

Direct Access, on the other hand, gives you a multitude of utterly sensible program groupings – 17 of them.

And that doesn't count the customized ones you dream up yourself.

What does all this mean to you?

It means you can get to a spreadsheet by simply clicking "Spreadsheet." Summon a word processor by stroking "W." And access a DBMS by selecting, you guessed it, "Database."

Direct Access searches your hard disk, groups your applications logically and generates menus and submenus automatically. All you have to do is point and click.

You can even park your favorite programs right on the main menu and ask for them by name.

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You can decide for yourself precisely who gets access to which menu items.

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FIFTH GENERATION SYSTEMS, INC

CIRCLE 288 ON READER SERVICE CARD

(Wilmington, Massachusetts; 800-950-9327, 617-221-7555) and Valitek (Amherst, Massachusetts; 800-825-4835, 413-549-2700) both provide such devices. Each interfaces to the PC through the parallel port, but Valitek also offers drives with both parallel and serial interfaces. In addition, the Quan-Tech drive has a SCSI port. Quan-Tech's units range from $995 to $2,495; the highest-capacity drive is 525MB. Valitek's drives range from $1,595 to $2,095, and each stores a more modest 60MB to 250MB. For those who require a full line of storage devices, Micro Solutions (DeKalb, Illinois; 815-756-3411) offers its Backpack family of external hard disks, floppy disk drives, and tape drives; prices range from $299 to $825.

If you need access to data on a CD-ROM, Toshiba America Information Systems (Irvine, California; 800-334-3445, 714-583-3000) and NEC Technologies (Wood Dale, Illinois; 800-632-4636, 708-860-9500) offer portable battery-powered CD-ROM drives. Both products are designed with SCSI interfaces and have optional parallel-port adapters that work with almost any PC. Many SCSI devices in general support parallel-port interfaces, but just as many do not. To support these drives, Trantor Systems (Fremont, California; 510-770-1400) has developed the $229 MiniSCSI Plus. This little adapter converts almost any parallel port to a SCSI host adapter.

Personics' Laptop UltraVision

One big limitation in the use of portables is the power that drives them. Statpower Technologies (Point Roberts, Washington; 604-420-1585) offers a full line of power accessories. Its converter (12 volts to 120 volts) plugs into a cigarette lighter and lets you use an AC portable in a car. It can also recharge the batteries of notebook computers that do not offer auto adapters. Statpower's portable battery pack can extend the life of a battery-powered portable and even give limited battery life to AC portables.

POINTING IN THE RIGHT DIRECTION

To improve your portable's keyboard, Genovation offers a family of keyboards and numeric keypads that attach to a computer's printer port (Irvine, California; 714-833-3355). The company also offers a special adapter that enables any ATor PS/2 keyboard to be used through the serial port.

Many people think a portable computer's user interface is limited to the keyboard, but Microsoft Windows users need a mouse. (We reviewed the major products in this category in our issue of October, 15, 1991.) Logitech (Fremont, California; 800-231-7717, 510-795-8500) and Microsoft Corp. (Redmond, Washington; 800-426-9400, 206-882-8080) dominate the market with their pointing devices, which mount to the side of most portables. Logitech's TrackMan Portable costs $169; the Microsoft BallPoint Mouse lists for $175.

Appoint (Paso Robles, California; 800-448-1184, 805-239-8976) offers a few alternatives to traditional mice and trackballs. Thumbelina ($99) is a miniature trackball that measures just 1.6 inches square and easily fits in one hand, while the Appoint MousePen ($99) is held like a pen, allowing users to "draw" their commands. Appoint has recently announced Viper, a miniature mouse that reportedly operates on any surface at any angle.

A final alternative to the traditional mouse is the $49.95 No Mouse for Windows (from Abacus Software, Grand Rapids, Michigan; 800-451-4319, 616-698-0330). This software-only package for Windows provides pointer movement and selection using the keys on the keyboard (reviewed in First Looks, January 28, 1992).

SEEING MORE CLEARLY

Two cursor-enhancement products, the $49.95 Cursorific! (Apex Software, Reno, Nevada; 800-728-7650), which we reviewed in New & Improved, March 17, 1992; and the $49.95 Magic Cursor (Fanfare Software, Northridge, California; 818-886-8787) enlarge your cursor on hard-to-read LCD screens. Both packages let you customize your cursor as well. Microsoft's newest mouse driver, Version 8.1, performs the same function and can even leave behind a "mouse trail" for the slowest of laptop displays.

The newest generation of LCDs, especially the active-matrix color panels, provide a vast improvement over the screens

Logitech's TrackMan Portable

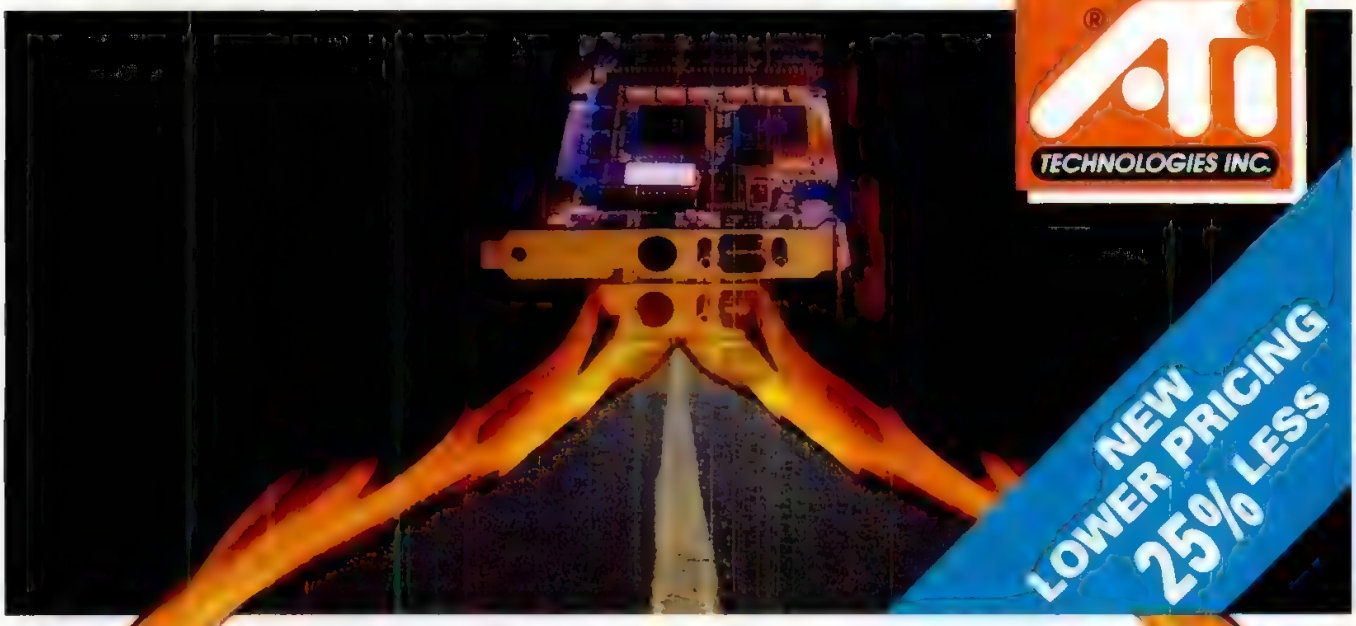
on the market a few years ago. Nonetheless, the screens are not always as readable as we would like. SkiSoft offers two software packages to improve the character-based world (Lexington, Massachusetts; 800-662-3622, 617-863-1876). The $129.95 Eye Relief for Laptops is a text editor with adjustable-size type; the $49.95 No-Squint II provides a large cursor for use in most DOS character–based applications.

While Eye Relief provides editing that is easy on the eyes, the $69.95 Laptop UltraVision offers improved readability to users of most character-based applications (Personics, Maynard, Massachusetts; 800-445-3311, 508-897-1575). UltraVision allows you to adjust the character size, cursor size, and shape, and gray-scale/color settings. It also stretches character-based screens to the full display capability of your notebook's LCD.

Along with visual output, some applications call for audio. Media Vision (Fremont, California; 800-348-7116, 510-770-8600) has announced a new product, an "audio port" called the Media Vision CDPC. This small battery-powered sound module attaches to the parallel port of any PC, so it is perfect for portables short on internal expansion.

PROTECTING YOURSELF

Security is becoming an increasing concern for all computer users, and it is especially important for owners of portables.



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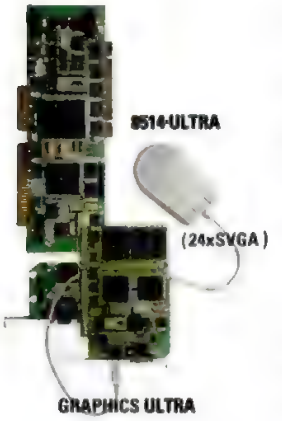

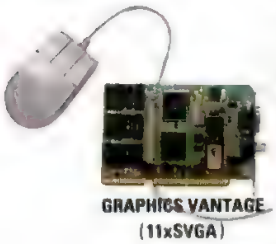

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Perfecting the PC

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CIRCLE 337 ON READER SERVICE CARD

Corporate Management Group (Austin, Texas; 800-880-9980, 512-329-8220) makes security products, including a password system, data-encryption software, and various types of locks to prevent unauthorized access to the floppy disk drive or keyboard. Datamedia Corp. (Nashua, New Hampshire; 603-886-1570) offers an access control system—the $95 Securecard/100— based on the "something known and something possessed" scheme that is used by automatic teller machines (ATMs). The package includes a specially manufactured copy-protected disk and a password, file encryption utilities, and suspend/resume drivers to prevent illicit system access.

Despite the best security efforts, theft may occur. IDX Technologies offers the $49 Computer Owner Protection (COP) program (Setauket, New York; 800-645-5404, 516-689-9866). If a COP-equipped computer is recovered by police, they can forward a special code it produces to an 800-number service bureau that will identify the registered owner of the stolen property.

DOCKING BAYS AND DESKTOP CONNECTIONS

While portable computers are designed with travel in mind, most of today's notebooks are powerful enough to serve double duty as desktop computers. But to fulfill this type of functionality, they usually need additional expandability and connectivity. The latest generation of docking stations from the major laptop manufacturers—companies such as AT&T, Compaq, GRiD, NEC, Toshiba, and Zenith Data Systems—provide just that. ZDS (Buffalo Grove, Illinois; 800-523-9393; 708-808-5000) has developed a special low-cost docking unit that lets you connect your Z-Note notebook computer (which unfortunately was not ready in time to be included in "Notebook PCs: Fitting the World Inside Your Briefcase," in this issue) to all of the cables required for the desktop environment. With one simple snap, the $149 Readydesk Port Replicator connects the ZDS notebook with an enhanced parallel port, a serial port, two PS/2 ports (keyboard and mouse), a Super VGA video port, and a plug for AC power.

A healthy third-party docking-station market also exists. For those who want more slots or drive bays, Axonix (Salt Lake City, Utah; 800-866-9797, 801-466-9797) offers a line of third-party expansion units with enough room for up to eight slots, two 3.5-inch drive bays, and two 5.25-inch bays. These units are compatible with most of the major portables equipped with an expansion port or slot. Another alternative comes from Lightek (Kent, Ohio; 216-673-5358). In addition to units that connect to portables with expansion ports and slots, Lightek has an expansion station that connects through the parallel port, so it can be used with almost any portable (or desktop) computer available.

For those who are looking to expand older Toshibas, WonUnder Products (Minneapolis, Minnesota; 612-334-3211) offers an expansion slot that mounts to the bottom of most Toshiba notebook computers, the $498 WonUnder Cradle. And the $595 Central Station provides network access, one parallel port, and two serial ports to any computer with a parallel port (Artisoft, Tucson, Arizona; 800-846-9726, 602-293-4000).

An expansion unit may be overkill if the only desktop connectivity you require is networking. A number of companies, including Accton Technology (Fremont, California; 800-926-9288, 510-226-9800), D-Link Systems (Irvine, California; 714-455-1688), IQ Technologies (Bothell, Washington; 800-227-2817, 206-483-3555), and Xircom (Calabasas, California; 800-874-7875, 818-878-7600) have developed network adapters that connect to the parallel port. Xircom's $495 Pocket Ethernet Adapter II is the most well known and currently supports faster transmissions to systems that support an enhanced parallel port.

Xircom's Pocket Ethernet Adapter II

Megahertz Corp. (Salt Lake City, Utah; 800-527-8677, 801-272-6000) offers another way to circumvent the speed limitation of the parallel port; it manufactures a line of network cards that are attached to the high-speed bus connector available on most Toshiba portables. Since these adapters connect directly to the system bus, they perform at the same rate as typical network cards.

Many portable computer users also have a desktop computer that is already connected to a LAN. For them, the $149 Lap2Lan may be the answer (East Coast Software, Atlanta, Georgia; 800-829-8713, 404-455-8773). This package contains software and a parallel-port cable that connect the laptop to the desktop. The software allows the two computers to share the network card in the desktop, giving the laptop direct access to LAN resources.

For other users, access to the desktop computer may be all that is needed. In this case, a parallel- or serial-port file-transfer utility may be the best solution. Traveling Software (Bothell, Washington; 800-343-8080, 206-483-8088) dominates the market with its popular $169.95 LapLink Pro (reviewed in "LapLink Pro: Full-Featured Support for Simpler Needs," February 25, 1992). Rupp Technologies provides file transfer utilities as well (New York, New York; 800-852-7877, 212-517-7775).

Many of the accessories designed for portable computers connect to the system through the parallel port. Some of these devices have a pass-through parallel port so a printer can still be used when the device is attached. For those devices that do not have a pass-through connector, Xircom has developed a parallel-port multiplexer. This small adapter converts a portable computer's single parallel port into two parallel ports, allowing for the simulta-

neous connection of two parallel devices.

Most accessories add new functionality to the portable computer, but sometimes all you need is more memory and a larger hard disk. Most major manufacturers offer upgrades, but their prices tend to be high. Apricorn (San Diego, California; 800-458-5448, 619-271-4880) and Kingston Technology (Fountain Valley, California; 800-835-2545, 714-435-2600) are two of the many vendors that offer more affordable memory upgrades. Laptop Solutions (Houston, Texas; 800-683-6839, 713-789-0878) manufactures approved hard disk upgrades for AT&T, Tandy, and Toshiba portables.

While most accessories add functionality, sometimes all you need is more memory and a larger hard disk.

A CASE TO CARRY IT IN

After you have selected your accessories, the next step is to choose a case to carry them in. Most computer manufacturers offer custom cases for their laptops, but there is also a wide variety of third-party cases. Solidex offers one of the broadest lines of cases, including its new Compushield line, which ranges from $49.99 to $169.99 (San Dimas, California; 800-722-1888, 714-599-2666). Targus (Buena Park, California; 714-523-5429) offers an oversize leather case that can carry a computer, printer, and desk full of file folders.

Other manufacturers to check out include Tenba (New York, New York; 800-221-6650, 212-966-1013), Note Tote (Issaquah, Washington; 800-344-7890, 206-392-9475), and Innovative Manufacturing (Miami, Florida; 305-836-1035).

If you'd like to find out more about laptop accessories and expansion possibilities, consult product catalogs that specialize in portable computers. Two such catalog vendors are Computer Products Plus (800-274-4277) and The Complete Portable (Prospect Heights, Illinois; 800-328-4827 ext. 3317, 708-577-6342). □

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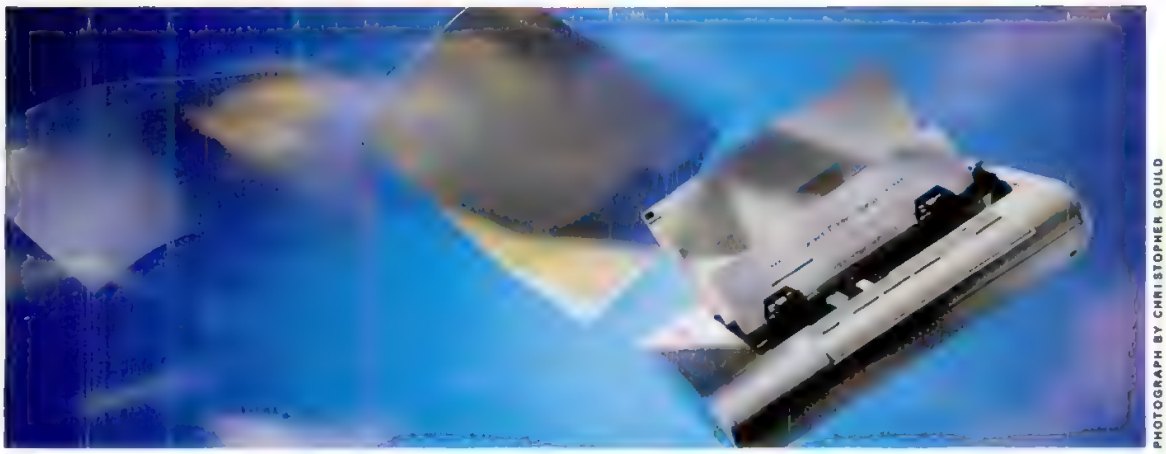

PHOTOGRAPH BY CHRISTOPHER GOULD

SMALL, LIGHT, AND CAPABLE

Portable Printers Deliver a Triple Play

These seven printers weigh no more than 7 pounds each with AC adapters and batteries, and they deliver quality text output for under $500 (street price) in their standard configurations. Some are suitable for use on the desktop, as well as on the road.

From the executive sending out letters while on the road, to the traveling salesperson outputting presentations on transparencies, to the field representative generating draft reports before leaving a site, users are finding that portable printers help make the portable office more of a reality today than ever before.

Manufacturers sold about 290,000 portable printers in 1991, up from 210,000 in 1990, according to BIS Strategic Decisions of Norwell, Massachusetts. BIS projects sales of some 840,000 portable units (or one of every dozen printers sold) in 1995.

As the market has grown, so have the options for users. For example, the tiny

IN THIS REVIEW

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Toshiba ExpressWriter 201	*367*

By Mitt Jones and Jennifer Zaino

Citizen PN48 Notebook Printer introduced last year gave travelers a portable they could live with. Weighing only 2.2 pounds without its battery, the Citizen PN48 packs easily alongside a notebook PC and generates hard copy that might almost have come from a laser printer. The newer Toshiba ExpressWriter 201 nearly matches the Citizen PN48 in size, though not in output quality.

Despite the current and projected sales increase of portable printers, however, the market for printers positioned as laptop accessories is finite. Because not every laptop user requires a portable printer, portable printer sales don't come close to laptop purchases. (BIS calculates that 1.5 million portable computers were sold in 1990 and 1.9 million in 1991, and it projects sales of 4 million in 1995.)

Recognizing that, some manufacturers are trying out options to attract a different class of buyer. They offer portable printers that can also serve as desktop units—a handy alternative for users who require on-the-road printing only on occasion or who plan extended trips away from the office.

Weightier systems, such as the new Kodak Diconix 701 Printer (7 pounds including all its options), don't travel nearly as well as the Citizen PN48, but offer tradeoffs in speed and convenience. The Kodak 701, for instance, includes a built-in 30-page sheet feeder. The Canon BJ-10ex Bubble Jet Printer, a slightly revised version of Canon's venerable BJ-10e, straddles the gap between both worlds with its low 5.3-pound weight (including battery and adapter) and optional sheet feeder, which can be detached in just a few seconds.

Keep in mind, however, that while several of the products reviewed here will suffice as small-footprint desktop machines, none provide both the speed and full range of features you can expect from a comparably priced desktop model.

HIGHLIGHTS

Portable Printers

THE SEVEN portable printers reviewed here cost under $500 street price, provide quality text output, and come in compact packages. The heaviest, the Kodak Diconix 701 Printer, weighs only 7.0 pounds (with AC adapter and battery), while the tiny Citizen PN48 Notebook Printer weighs a mere 3.8 pounds with all its options.

PRODUCTS LIKE the Citizen PN48 and the nearly identical Toshiba ExpressWriter 201 are the prime candidates for users who are frequently on the road. Some of the other units are aimed at users who need a desktop printer that can also make the occasional road trip. The Kodak 701, for example, offers desktop-like convenience with its built-in sheet feeder.

OF THIS ROUNDUP, only the Kodak Diconix 180si Printer specifically claims support of continuous feed paper, courtesy of its internal tractor feed mechanism.

ALL BUT ONE of these printers support batteries as extra cost options (ranging from $50 to $125). The DECjet 1000 is AC-only.

THE PRINTERS reviewed here break down into two categories. The Citizen PN48 and the ExpressWriter are thermal fusion printers; the rest rely on ink jet technology.

THE COSTS per page for the thermal fusion printers range from 36 to 41 cents, assuming a single use of their multistrike ribbons and 2,500 characters per page. The ink jet printers provide per-page costs of less than 12 cents.

THE DOWNSIDE to ink jet technology is that for most of these printers the ink tends to smear before drying or if it gets wet.

THE CITIZEN PN48 took the lead with its output quality, but the Kodak 701 and the DECjet were overall speedier performers.

REVIEW CRITERIA

To be reviewed in this roundup, each printer had to support a battery option or weigh under 10 pounds including sheet feeder (or both) and had to have been introduced or substantially revised since *PC Magazine*'s November 26, 1991, annual printer issue.

Products that made the cut include the $499 Brother HJ-100i Ink Jet Printer (a licensed version of the Canon BJ-10e), the $329 DECjet 1000, the $399 Kodak Diconix 180si Printer, the $549 Kodak Diconix 701 Printer, and the $499 Toshiba ExpressWriter 201. The ExpressWriter is based on a mechanism similar to the Citizen PN48's, but offers only half of that unit's 360-dot-per-inch (dpi) resolution.

Even though the best-selling $499 Canon BJ-10ex and the $469 Citizen PN48 are neither new nor significantly changed since we last reviewed them, we included these past *PC Magazine* Editors' Choice winners to see how well they stack up against the new offerings.

The $529 Data General Model 6694, a repackaged version of the discontinued Kodak Diconix 150 Plus, qualified for this review, but the company declined to participate. The Axonix MilWrite, a $1,395 heavy-duty impact dot matrix offering, was not available in its commercial version in time for testing, but it will be by the time you read this.

Three additional offerings that were reviewed in the November 26, 1991, issue deserve a special mention. The 8-pound, $1,295 Mannesmann Tally MT735 includes PCL Level 4 emulation and distinguishes itself as the only portable page printer shipped to date. The 6-pound, $499 Seikosha LT 20, an impact dot matrix portable, allows printing of carbon forms. Like the Brother HJ-100i, the $499 Star Micronics StarJet SJ-48 is a repackaged version of Canon's portable printer.

WEIGHING THE OPTIONS

Those who travel a lot will want a printer as small and as light as possible. Like the Citizen PN48, the Kodak 180si and the ExpressWriter each weigh between 3 and 4 pounds, including accessories, and will fit in a briefcase alongside a laptop.

If you expect your portable to also serve as a desktop printer, you'll do well to focus more on paper-handling capabil-

ities than on size and weight. The same holds true if your travel keeps you in one location for long stretches. Of the printers reviewed here, the Kodak 701 distinguishes itself as the only model with a built-in cut-sheet feeder. The Canon BJ-10ex and its near-twin, the Brother HJ-100i, offer sheet feeders as $90 options, but we experienced jamming problems with both during our evaluation. The Kodak 180si, with its internal tractor-feed mechanism, stands out as the only product reviewed here that specifically claims support of continuous-feed paper.

Although BIS estimates that only 10 percent of portable printer owners actually run the printers off batteries when on the road, all but one of the products reviewed—the DECjet—support battery-powered operation. In each case, batteries are an extra cost option, ranging from $50 to $125.

Those who do plan to power their printer via a battery should pay attention to the number of pages each model can print on a full charge. The Kodak 701, for instance, claims 100 pages per charge, while the Citizen PN48 and Kodak 180si claim 30 pages or less.

THERMAL VS. INK JET

Each of these printers employs near-silent, non-impact technology. Based on thermal fusion technology, the 360-dpi Citizen PN48 generates blacker, crisper print than seems possible from a dot matrix printer that is so small. But the unit does so at a hefty cost per page: 36 cents per page using the single strike ribbon (assuming 2,500 characters per page), though costs drop with the multistrike ribbon, which can be flipped over for a second use. With a ribbon life of about 25 pages for the single-strike cartridge, you'll also need plenty of spares.

Only the ExpressWriter, which also relies on thermal fusion technology, prints at a higher cost per page than the Citizen PN48: 41 cents per page, assuming a single use of the multistrike ribbon. (Reusing the ExpressWriter's multistrike ribbon led to ghosting problems.)

The other products rely on ink jet technology. The 50-jet, 300-dpi Kodak Diconix 701 and 64-jet, 360-dpi Canon BJ-10ex (and Brother HJ-100i) each proved capable of printing text with admirably smooth edges, but none printed as dark as the Citizen PN48. The Citizen PN48 also outshone all the competition with its graphics output. (For output examples, see the Printer Guide and the individual font samples, which are included in each review.)

In their favor, the ink jet printers each provide a cost per page of under 12 cents (again assuming 2,500 characters per page). But one drawback of ink jet printers is that the ink used by some models—all but the Kodak 180si in this roundup—tends to smear before drying or when contacted with moisture. On the other hand, the fairly dark print of these capable ink jet offerings will suffice for most uses, and a typical print head or ink cartridge prints at least a few hundred pages.

BENCHMARK TEST RESULTS

How much weight you give a printer's tested performance should depend largely on whether your portable will spend most of its time tucked into a shoulder bag or standing ready on a desktop. Don't expect these printers to match the text speed output of the 64-nozzle desktop ink jet printers or the fastest 24-pin dot matrix printer reviewed in last year's printer issue. (The ink jet printers clocked in at 115 characters per second,

EDITORS' CHOICE

- **Citizen PN48 Notebook Printer**
- **Kodak Diconix 701 Printer**

Both the frequent and the occasional business traveler should find a portable printer to suit their needs among the seven reviewed here. Each product has merits, but two stand out as winners in their respective markets: the $469 Citizen PN48 Notebook Printer and the $549 Kodak Diconix 701 Printer.

By virtue of its low weight (3.5 pounds with all its options), the 360-dpi Citizen PN48 is a fine choice if you spend more time away from the office than in it. With its excellent text and graphics output, the Citizen PN48 covers you for everything from formal correspondence to touch-ups for a presentation. On the downside, you have to manually feed cut-sheet paper, the 36-cents-per-page cost is high, and speed is not this printer's forte. But these problems won't keep away frequent travelers who want the smallest and lightest device available.

If you're looking for a printer that can serve both on the desktop and on the occasional road trip, you'll want a device with better paper handling, a lower per-page cost, and faster performance than the Citizen PN48: the Kodak Diconix 701 Printer.

The Kodak 701 is unique in that it includes a built-in sheet feeder, which proved easier to work with than did the jam-prone optional feeders from Canon and Brother.

The Kodak 701 was also one of the best performers we saw, managing 48 cps in quality mode. Its Courier font is fine for most business uses, and its graphics output is smooth.

At 7.0 pounds (with a battery and an AC adapter/charger), the Kodak 701 isn't a top choice for travelers constantly on the move. But it will impress anyone looking for a small-footprint machine that can also function as a desktop device.

Honorable mentions go to the Canon BJ-10ex Bubble Jet Printer and the Brother HJ-100i Ink Jet Printer, each at 5.3 pounds and $499. These two offer lower per-page costs than the Citizen PN48 in packages that are more modestly sized than the Kodak 701. The Kodak 701 is more adept at paper handling, and both it and the Citizen PN48 provide better graphics, but the Canon and Brother printers do feature high-quality text output and good speed.

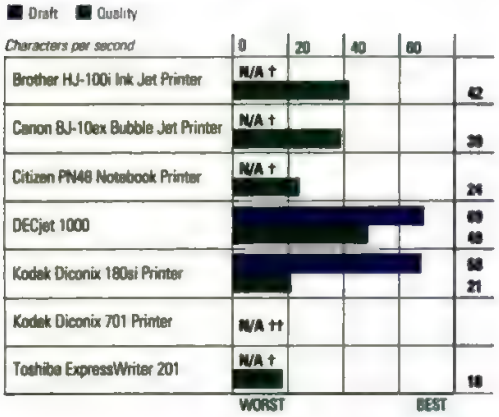
Benchmark Tests: Portable Printers

The DECjet 1000 and the Kodak Diconix 701 Printer distinguished themselves as the two fastest performers of the group on the Text Speed (Quality) test. On the Graphics Speed test, the Kodak 701 took top honors in IBM emulation mode, while the Brother HJ-100i Ink Jet Printer took the lead in Epson emulation mode.

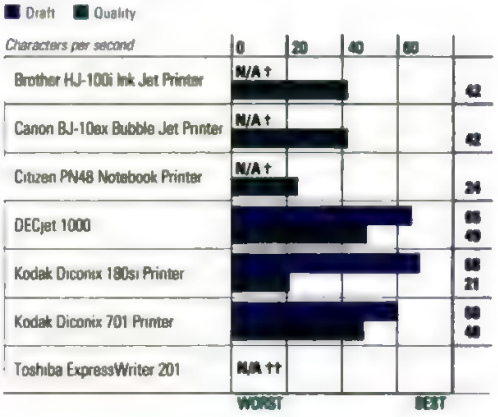
TEXT SPEED

The **Text Speed** test measures the time it takes to send and print one copy of a two-page business letter with 1-inch margins in 10-cpi type. The test is performed twice for each emulation, once in draft mode (if available) and once in quality mode.

Epson Emulation



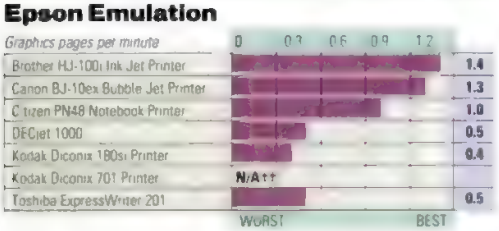
IBM Emulation



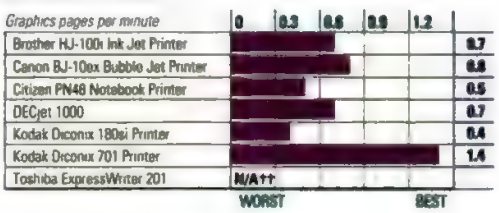
GRAPHICS SPEED

The **Graphics Speed** test measures the time it takes to send and print two copies of a graphics image created using PageMaker and Microsoft Windows.

Epson Emulation



IBM Emulation



HOW WE TESTED

Each of the seven portable printers was tested using a Compaq 386/25e running Compaq DOS 5.0 and equipped with 8MB of RAM and a 310MB ESDI hard disk. We used PC Magazine Labs' printer test suite to obtain the results for the Text Speed and Graphics Speed tests.

Our Text Speed test is a two-page business letter. For this test, we report the result in each printer's highest-quality mode and results in draft modes for those printers that support it. Speeds are reported in characters per second.

The scanned-in photo of associate editor Mary Kathleen Flynn doubles as our output sample and our Graphics Speed test. Results are reported in graphics pages per minute.

Both tests are performed using Epson and IBM emulations. (The Toshiba ExpressWriter 201 does not support an IBM emulation, and the Kodak Diconix 701 Printer does not support an Epson emulation.)

N/A †—Not applicable. This printer does not operate in draft mode.

N/A ††—Not applicable. This printer does not support this emulation.

while the fastest 24-pin dot matrix, the $1,395 NEC Pinwriter P9300, delivered 89 cps in quality mode.) The portables' text output speed is comparable with that of some of the slower desktop dot matrix printers we looked at last year.

Under Epson emulation, the Brother HJ-100i turned in the second-best quality text score of 42 cps and the fastest graphics speed of 1.4 graphics pages per minute (gppm). The DECjet led the field for both draft and quality text—at 69 cps and 49 cps, respectively—but dropped to second slowest on graphics. The ExpressWriter turned in the slowest quality performance (18 cps) and a lackluster graphics score of 0.5 gppm.

Under IBM emulation, the DECjet and the Kodak 701 turned in the best text performance in quality mode, clocking in at 49 and 48 cps, respectively. But in draft mode, the Kodak 180si took top honors at 68 cps. At 1.4 gppm, the Kodak 701 led its competition on the graphics test, with the Canon BJ-10ex placing a distant second at 0.8 gppm. The Citizen PN48 and the Kodak 180si fared the worst on the quality text and graphics tests.

The differences in graphics speeds between Epson and IBM emulations can be attributed in part to the resolution of the test images: 360 dpi for the IBM Proprinter emulation and 180 dpi for the Epson LQ emulation.

In most cases, PC Magazine Labs' testing methodology specifies the use of continuous-feed paper when evaluating dot matrix and ink jet printers, whether or not the printer claims to support such paper. This is done to avoid the paper-handling overhead that occurs with single sheets, whether fed by hand or by a sheet feeder. Among the products reviewed here, the Brother HJ-100i, Canon BJ-10ex, DECjet, and Kodak 701 could not

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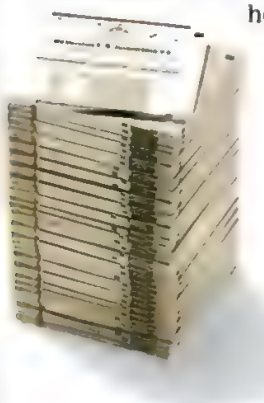

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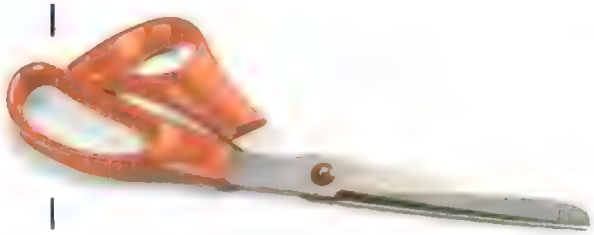

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accommodate continuous-feed paper, yet generally provided faster results than the Citizen PN48, Kodak 180si, or ExpressWriter, which were tested with continuous-feed paper.

THE FINAL WORD

As with any collection of printers, portable printers differ in many ways. For example, while all of the products reviewed here support an Epson or an IBM emulation (or both), the Kodak 701 and the DECjet distinguish themselves by emulating an HP DeskJet. The systems also vary in the quality and number of internal fonts, ranging from the two included with the units from Citizen and Toshiba to the four fonts packaged with the printers from Canon and Brother. In this group, you'll also find portables, such as the Kodak 701, that support downloadable fonts and landscape printing of internal fonts.The access to features from the control panel varies widely; the Citizen PN48 has a 1-character LED display to help you navigate its configuration menu.

Microsoft Windows users will want to check whether the product comes with its own Windows 3.1 driver (as do the two Kodak offerings), whether the company will provide a driver via disk or BBS (as does Citizen), or whether Windows itself includes a driver for that specific printer. You will get fuller support of your printer's internal fonts and other features with a Windows driver.

Probably the most important thing to consider when making your decision is where your printer will spend most of its time. A model that seems too good to be true for frequent overnight travel might prove woefully inadequate if expected to double as your desktop printer, and vice versa. The following reviews will help you decide which of these seven printers best suits your needs.

Brother International Corp.

Brother HJ-100i Ink Jet Printer

Canon USA Inc.

Canon BJ-10ex Bubble Jet Printer

BY JEFFREY HSU

Canon USA made its impact on the portable printer market with the Canon BJ-10e's high-quality text output and compact size. These same features appear in the latest incarnation, the $499 Canon BJ-10ex Bubble Jet Printer, which adds an Epson LQ emulation to the existing IBM Proprinter and native emulations. A similar package, the Brother HJ-100i Ink Jet Printer, from Brother International Corp., substitutes the Brother HJ-100 emulation for the Canon emulation, but otherwise resembles the Canon BJ-10ex in almost every detail, including list price.

The Brother HJ-100i is the latest printer to be based on the Canon's 64-nozzle engine and 1.9- by 12.2- by 8.5-inch case. The Canon BJ-10e and the Brother HJ-100i each weigh 4 pounds without add-ons. With battery and AC-power adapter, the traveling packages go up to 5.3 pounds.

FACT FILE

Brother HJ-100i Ink Jet Printer

Brother International Corp., 200 Cottontail Ln., Somerset, NJ 08875-6714; 908-356-8880; fax, 908-469-5167

List Price: $499 (includes AC adapter/charger, power and connecting cables, and one ink cartridge) Nickel cadmium battery, $50, 30-page sheet feeder, $90, extra ink cartridge, $25

Requires: Parallel port

Dimensions (HWD): 1.9 x 12.2 x 8.5 inches, 4.2 x 12.2 x 8.5 inches with sheet feeder

Weight: 4.0 pounds, 4.6 pounds with battery, 5.3 pounds with battery and AC adapter

Emulations: Epson LQ-510, IBM Proprinter X24E, and Brother HJ-100

In Short: A good choice for use on the desktop and on the road, the Brother HJ-100i Ink Jet Printer is a virtual clone of the Canon BJ-10ex Bubble Jet Printer; both offer the same quality text output and good speed. The only real difference between the two printers will be the street prices that you find.

551 ON READER SERVICE CARD

Brother HJ-100i Ink Jet Printer

Courier
Get your facts first

Prestige Elite
Get your facts first

Get your facts first

Roman
Get your facts first

TWO OF A KIND

For each ink jet printer, the list price includes an AC adapter, one ink cartridge, and power and connecting cables. Even the printers' street prices are close; the Canon BJ-10ex can be found for around $340 and the Brother HJ-100i for closer to $300. An optional $50 nickel cadmium battery can keep either printer going for about 18 pages. Canon and Brother each offer a 30-page cut-sheet feeder for $90 and extra ink cartridges for $25 a piece. The cartridges print up to 700,000 characters in quality mode, for an output cost of 9 cents per page. In near-letter-quality mode, the cost drops to 4 cents a page because the printer is using less ink.

Canon BJ-10ex Bubble Jet Printer

Courier
Get your facts first

Prestige Elite
Get your facts first

Sans Serif
Get your facts first

Roman
Get your facts first

The two printers differ from each other in mostly minor ways. For example, the Canon has raised control panel buttons, while the Brother uses membrane-style buttons.

Among the many features the two printers have in common is the inclusion of Roman, sans serif, Courier, and Prestige Elite fonts. The first two are available only under the Epson emulation, however, and the latter under the IBM Proprinter emulation. Both printers also pro-

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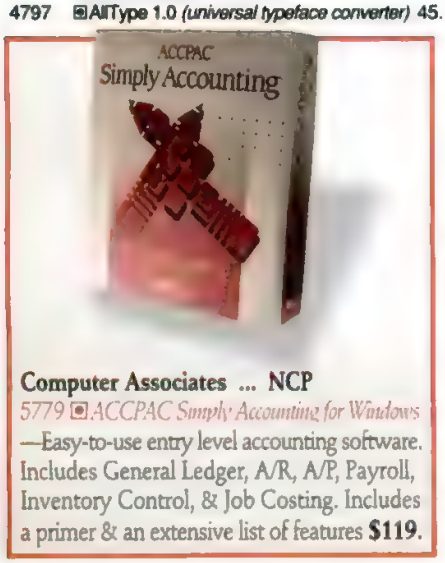
The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

SOFTWARE

We carry only the latest versions of products. Version numbers are current at press time. Products listed here in red are Microsoft Windows Applications.

Abracadata ... NCP
5591 ▣Everybody's Planner 2.0 ... 49.
AddStor ... NCP
4090 ▣SuperStor 2.0 ... 79.
Adobe Systems ... NCP
7547 ▣Adobe Type Manager 2.0 for Windows 65.
6591 ☐Adobe Illustrator 4.0 for Windows ... 389.
5988 ☐Adobe Illustrator Competitive Upgrade 189.
(Entire Adobe Type Library, from 1 to 265 is available. Call for more information.)
Aldus ... NCP
8000 ☐Persuasion 2.1 for Windows ... 329.
1341 ☐FreeHand 3.1 for Windows ... 395.
1332 ☐PageMaker 4.2 for Windows ... 499.
6223 ▣Gallery Effects for Windows ... 139.
Alpha Software ... NCP
5104 ▣Alpha FOUR 2.0 ... 329.
Application Techniques ... NCP
1214 ▣Pizazz Plus 3.0 ... 79.
Approach Software ... NCP
6598 ▣Approach 1.0 for Windows. *intro. price* 139.
Ares Software ... NCP
6030 ▣FontMonger 1.0 for Windows *(June '92)* 95.
Artisoft ... NCP
2455 Lantastic AE-2 EtherNet Starter Kit 4.1 *(incl. software, 2 EtherNet cards, cable)* 479.
2452 AE-2 EtherNet Adapter Card ... 199.
Atech Software ... NCP
4797 ▣AllType 1.0 *(universal typeface converter)* 45.

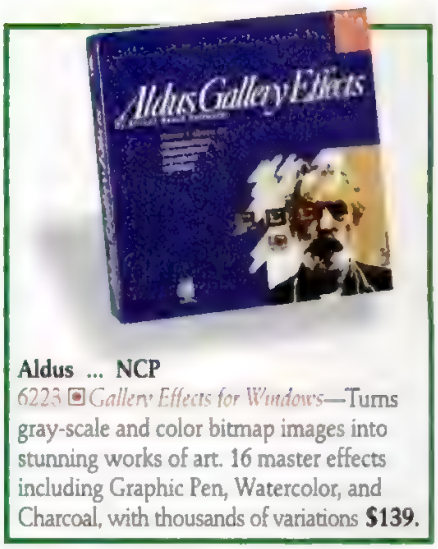


Computer Associates ... NCP
5779 ▣*ACCPAC Simply Accounting for Windows*—Easy-to-use entry level accounting software. Includes General Ledger, A/R, A/P, Payroll, Inventory Control, & Job Costing. Includes a primer & an extensive list of features **$119.**

5708 ▣FastFonts DOS $57. 5718 Windows $57.
5707 ▣All Fonts for Home 45. 5706 Business 45.
Attitash Software ... NCP
8846 ▣WideAngle 2.0 ... 59.
5183 ▣AttiTools 1.0 ... 59.
Automap... NCP
2729 ▣Automap 2.0 ... 49.
Avery Dennison ... NCP
6006 ▣Label Pro 1.6 *(Laser)* ... 49.
7336 ▣Label Pro 1.6 for Dot Matrix ... 49.
Banner Blue Software ... NCP
2088 ▣Org Plus 1.0 for Windows ... 125.
Berkeley Systems ... NCP
9885 ▣After Dark 2.0 for Windows ... 29.
Bitstream ... NCP
7568 ▣FaceLift 2.0 for Windows 2.x/3.0 ... 59.
8040 ▣FaceLift 1.5 for WordPerfect 5.0/5.1 ... 59.
6066 ▣TrueType Font Pack for Windows 3.1 . 49.
2089 ▣MakeUp 1.0 for Windows 3.0/3.1 ... 95.
Borland International ... NCP
6242 ▣Quattro Pro 4.0 ... 319.
9695 ▣Borland C++ 3.0 ... 325.
1514 ▣Paradox 3.5 ... 499.
9635 ▣Object Vision 2.0 ... 99.
Broderbund ... NCP
1434 ▣New Print Shop ... 35.
ButtonWare ... NCP
6419 ▣PC-File 6.5 ... 85.
Caere ... NCP
8933 ▣Omnipage Professional 2.0 ... 649.

Adobe Systems ... NCP
5988 ☐*Adobe Illustrator 4.0 Competitive Upgrade*—Owners of draw/design programs can trade up to Illustrator 4.0 'til 8/31/92. Incl TypeAlign, ATM, Separator, 40 fonts, pre-drawn art, & more... **$189.**
6591 ☐*Adobe Illustrator 4.0 for Windows* ... **389.**

Calera ... NCP
1769 ▣Fax Grabber 1.0 ... 99.
1953 ▣WordScan Plus 1.1 ... 429.
Campbell Services ... NCP
5068 ▣On Time 1.1 for Windows ... 75.
Central Point ... NCP
5039 ☐PC Tools 7.1 ... 109.
6447 ☐PC Tools 7.1/AntiVirus 1.2 Bundle ... 144.
9751 ▣AntiVirus 1.2 ... 79.
8114 ▣Backup 7.1 *(DOS and Windows)* ... 79.
Claris ... NCP
5541 Hollywood *(3½" only) (incl. free book)* ... 339.
Clear Software ... NCP
5987 ▣AllClear 1.0 ... 179.
CompuServe ... NCP
7546 ▣DOS Membership Kit 1.3 ... 25.
Computer Associates ... NCP
5779 ▣ACCPAC Simply Accounting for Windows 119.
3814 dBFast *(3½" only)* ... 339.
Concentric Data Systems ... NCP
6575 ▣R & R Relational Report Writer 4.0 ... 159.
Contact Software ... NCP
1625 ▣Act! 2.1 ... 229.
Corel Systems ... NCP
5506 ☐CorelDRAW! 3.0 ... 395.
Data Storm ... NCP
4798 ▣PROCOMM PLUS 2.01 ... 79.



Aldus ... NCP
6223 ▣*Gallery Effects for Windows*—Turns gray-scale and color bitmap images into stunning works of art. 16 master effects including Graphic Pen, Watercolor, and Charcoal, with thousands of variations **$139.**

DCA/Crosstalk ... NCP
5611 ▣Crosstalk 1.2 for Windows ... 119.
2909 ▣Crosstalk Mk 4 2.0 ... 139.
Delrina Technology ... NCP
2446 ▣WinFaxPro 2.0 ... 75.
5974 ▣DOSFax PRO 2.0 ... 49.
Digital Research ... NCP
8288 ☐DR DOS 6.0 ... 67.
Fifth Generation Systems ... NCP
7725 ▣Direct Access 5.1 ... 64.
3950 ▣Fastback Plus 3.0 ... 119.
Fox Software ... NCP
6188 ▨FoxPro 2.0 ... 479.
Gibson Research ... NCP
9832 ▣SpinRite II 2.0 ... 64.
Hayes ... NCP
7983 ▣Smartcom EXEC 2.1 ... 75.
Helix Software ... NCP
9627 ▣Netroom 2.1 ... 52.
Hewlett-Packard ... NCP
8101 ▣NewWave 4.0 ... 109.
IBM ... NCP
2666 ☐DOS 5.0 Upgrade ... 59.
7303 ☐OS/2 2.0 Upgrade from DOS ... 95.
ICOM Simulations ... NCP
1326 ▣Intermission 3.0 for Windows ... 29.
5696 ▣Squeegee for Windows ... 42.
Individual Software ... NCP
6222 ▣Resume Maker 1.3 ... 29.
Inset Systems ... NCP
7298 ▣HiJaak 2.1 ... 139.
3820 ▣HiJaak 1.0 for Windows ... 139.
7300 ▣Inset Plus HiJaak ... 165.

Corel Systems ... NCP
5506 ☐*CorelDRAW! 3.0*—Adds graphic de-sign layers, editable preview, improved 3D, charting, painting and photo editing, presentation tools and CD-ROM ... **$395.**
2618 *CorelDRAW! 3.0 (CD-ROM only)*. **369.**

Don't get uptight.

Berkeley Systems ... NCP

9005 ☐ *After Dark 2.0 for Windows*—New! 40 incredible displays to prevent screen burn-in. 5 New Displays, Digital Sound, TrueColor Graphics, WallZapper, new fish, and MultiModule. DOS blanking to black. **$29.**

Intuit ... NCP

2426	☐ Quicken 5.0	45.
5596	☐ Quicken 1.0 for Windows	45.
6158	☐ QuickBooks 1.0	89.
6157	☐ QuickBooks with QuickPay	115.

LaserTools ... NCP

6882	☐ PrintCache 3.0	99.

Light Source ... NCP

7415	☐ Ofoto for Windows	269.

Lotus ... NCP

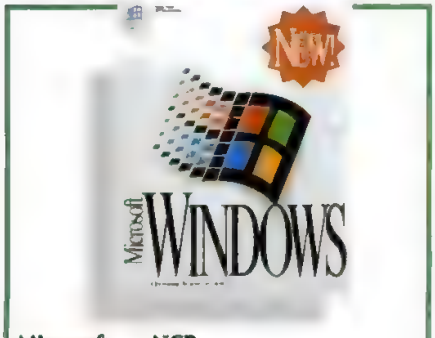
5417	☐ 1-2-3 3.1 Plus	399.
5653	☐ 1-2-3 2.4	335.
1852	☐ 1-2-3 2.4 Upgrade	99.
2755	☐ 1-2-3 1.1 for Windows	399.
5799	☐ Ami Pro 2.0	299.
1847	☐ Ami Pro Competitive Upgrade	95.
7812	☐ LotusWorks 3.0	95.
3523	☐ Freelance 1.0 for Windows	349.
5981	☐ SmartSuite	469.
2748	☐ cc:Mail Windows Platform Pack	325.

M-USA Business Systems ... NCP

3408	☐ Pacioli 2000 2.0 *(Accounting software)*	32.

MECA ... NCP

3978	☐ One-Write Plus Accounting 3.0	79.
4880	☐ One-Write Plus Accounting Works 3.0	119.
2798	☐ Managing Your Money 8.0	49.



Microsoft ... NCP

7010 ☐ *Windows 3.1*—Includes improved Setup, faster printing and better output with TrueType font technology, improved support for MS-DOS applications & drag and drop File Manager enhancements ..... **$89.**

Microcom ... NCP

6234	☐ CarbonCopy Plus 6.0	$119.
4410	☐ CarbonCopy Plus for Windows	119.

Micrografx ... NCP

3627	☐ Windows Draw! 3.0	85.

Micro Logic Software ... NCP

8579	☐ MoreFonts 3.0	75.

Microsoft ... NCP

3338	☐ Money 1.0 for Windows	45.
7010	☐ Windows 3.1	89.
7388	☐ Project 3.0 for Windows	445.
2904	☐ Works 2.0	95.
2735	☐ Works 1.0 for Windows	129.
3337	☐ Publisher 1.0 for Windows	129.
7387	☐ PowerPoint 2.0 for Windows	299.
6195	☐ Word 2.0 for Windows	299.
2856	☐ Excel 4.0 for Windows	299.
8137	☐ Office 2.5 for Windows	479.
1620	☐ MS-DOS 5 Upgrade	49.
1624	☐ Visual Basic 1.0	129.

Multisoft ... NCP

4925	☐ PC-Kwik Power Pak 2.1 w/Power Disk	79.

Niles & Associates ... NCP

3880	☐ EndNote Plus 1.0	149.

Nolo Press ... NCP

2982	☐ WillMaker 4.0	39.

New Version 3.0

Lotus ... NCP

7812 ☐ *LotusWorks 3.0*—Integrated business software with word processing, spreadsheet with graphics, database, and communications. Advanced windowing system with pull down menus makes it easy to use **$95.**

Norton-Lambert ... NCP

2753	☐ Close-Up for Windows & DOS Dual Pack	129.

Novell ... NCP

4000	☐ Netware Lite 1.0	69.

Okna ... NCP

9696	☐ Desktop Set 3.0 for Windows	49.

Palo Alto Software ... NCP

6940	☐ Business Plan Toolkit 4.0	75.

Panacea ... NCP

2413	☐ WinSpeed 1.0 *(Windows accelerator)*	55.

PC Globe ... NCP

5900	☐ PC USA 2.0	29.
5902	☐ PC Globe 5.0	39.

Peachtree ... NCP

5757	☐ Accounting for Windows	79.

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Lotus ... NCP

5981 ☐ *SmartSuite*—Your single solution for working in Windows. SmartSuite includes four full-featured, powerful business applications—*1-2-3 for Windows, Ami Pro, Freelance Graphics* and *cc:Mail*, all at a great price **$469.**

Personics ... NCP

9288	Laptop Ultravision 2.1 *(3½" only)*	59.
4384	☐ Desktop Ultravision	59.

Polaris Software ... NCP

4395	☐ PackRat 4.0	249.

PowerUp! ... NCP

7860	☐ Calendar Creator Plus 4.0	52.

Qualitas ... NCP

7539	☐ 386MAX 6.0	59.
7967	BlueMAX 6.0 for PS/2 *(3½" only)*	79.

Quarterdeck ... NCP

3221	☐ Expanded Memory Mgr. 386 6.0	59.
6589	☐ DESQview/X 1.0 *(includes blimp)*	169.

QUE Software ... NCP

3091	☐ RightWriter 5.0 for Windows	55.

Reality Technologies ... NCP

6572	☐ WealthBuilder 1.1	95.

Reference Software ... NCP

	☐ Instant Answers Series *(each include DOS & Windows versions)*	ea. 49.
4396	☐ Grammatik V 1.0	55.
7483	☐ Grammatik V 3.0 for Windows	55.

Roykore ... NCP

8162	☐ ABC Flowcharter 1.1	189.

Sitka ... NCP

6441	☐ 10NET 2 - Node Network Starter Pak	FREE
6440	☐ 10NET 3 - Node Network Expander	189.

Software Publishing ... NCP

3482	☐ Harvard Graphics 3.0	399.
4403	☐ Harvard Graphics 1.0 for Windows	369.

Spinnaker ... NCP

1415	☐ PFS: WindowWorks 1.0	95.

Stac Electronics ... NCP

1409	☐ Stacker 2.0	85.
3524	☐ Stacker 2.0 w/16-bit Coprocessor Card	185.

Stairway Software ... NCP

6430	☐ Screen Extender 2.0 for WordPerfect 5.0/5.1	59.

Symantec ... NCP

3784	☐ The Norton Backup 2.0 for Windows	99.
3146	☐ The Norton Utilities 6.0	115.
7999	☐ Norton Anti-Virus 2.0	84.
2359	☐ The Norton Desktop 2.0 for Windows	115.
8378	☐ Norton PC Anywhere 4.5	119.
3425	☐ Symantec Small Business Bundle	249.

3-D Visions ... NCP

6210	☐ Stanford Graphics 1.0 for Windows	369.

Teleware ... NCP

9847	☐ M.Y.O.B. for Windows	139.

TIMESLIPS ... NCP

5037	☐ TimeSheet Pro for Windows	135.
5698	☐ Timeslips Release 5	189.

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Micrografx ... NCP

3627 ☐ *Windows Draw! 3.0*—Full-featured drawing for Windows made easy. Includes a complete selection of drawing tools, flexible text handling, 2600 editable clip-art images, and an innovative user interface ..... **$85.**

Timeworks ... NCP

6253 ⊞ Publish-It! ..... 85.

Tool Technology ... NCP

3863 WinTools 1.0 for Windows *(3½" only)* .. 119.

Touchstone Software ... NCP

7420 ⊞ Check It 3.0 ..... 85.

Traveling Software ... NCP

4407 ⊞ LapLink Pro 4.0 ..... 99.

WordPerfect Corporation ... NCP

4214 ⊞ WordPerfect Office PC ..... 89.
3804 ☐ WordPerfect 5.1 ..... 269.
3494 ☐ WordPerfect 5.1 for Windows 279

XTREE. ... NCP

5975 ⊞ AllSafe 1.0 ..... 85.
6161 ⊞ XTree Gold 2.5 ..... 95.

RECREATIONAL/EDUCATIONAL

Abracadata ... NCP

3629 ⊞ Design Your Own Home-Architecture 3.0 49.
3641 ⊞ Design Your Own Railroad ..... 39.

Broderbund ... CP

3340 ⊞ Kid Pix ..... 35.
5851 ⊞ SimCity from Maxis ..... 29.
4411 ⊞ SimEarth for Windows from Maxis ..... 45.

Davidson & Associates ... NCP

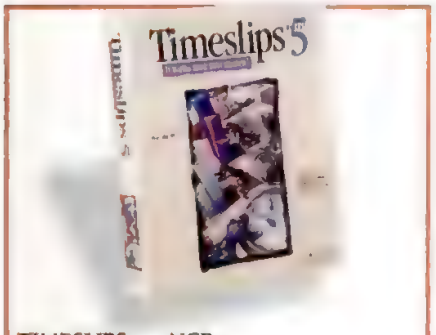
4183 ⊞ KidWorks ..... 29.

Harvard Associates ... NCP

2324 ⊞ PC Logo 4.0 ..... 59.

HyperGlot Software ... NCP

(French, German, Italian, Spanish available.)
☐ Word Torture for Windows ..... *ea.* 34.
☐ Word Torture 3.0 ..... *ea.* 29.



TIMESLIPS ... NCP

5698 ⊡ *Timeslips Release 5*—See where your hours are going with Timeslips Release 5. Re-engineered for today's business & service professionals. New features including multiple billing rates & many new reports .... **$189.**

Knowledge Adventure ... NCP

6456 ⊞ Isaac Asimov's Science Adventure ... $49.
3861 ⊞ Knowledge Adventure 1.0 ..... 49.

Microsoft ... NCP

2858 ☐ Flight Simulator 4.0 ..... 39.

Penton Overseas ... NCP

⊞ VocabuLearn/ce Levels I & II *(French, Italian, German, Spanish, Russian, Hebrew and Japanese)* ..... *ea.* 35.

Personal Training Systems ... NCP

Training tutorials-beg. to adv. for Windows, Excel, PageMaker WordPerfect, Ami Pro, Microsoft Word & Lotus 1-2-3 *(3½")* *ea.* 65.

Software Marketing Corp. ... NCP

5145 ⊞ Bodyworks 1.0 ..... 45.

Software Toolworks ... NCP

4534 ⊞ Mavis Beacon Teaches Typing 2.0 *(CP)* 31.
3031 ⊞ Mavis Beacon for Windows ..... 39.
3023 ⊞ ChessMaster 3000 ..... 35.
3032 ⊞ ChessMaster 3000 for Windows ..... 39.
5032 Miracle *(piano teacher) (incl. kybd.)* ..... 325.

Toyogo ... NCP

5138 ⊞ Go Master Deluxe 5.0 for Windows ..... 99.
5143 ⊞ Go Master Deluxe 5.0 ..... 99.

Walt Disney Computer Software ... CP

2629 ⊞ Mickey's 123's ..... 29.
2624 ⊞ Mickey's ABC's ..... 29.
6174 ⊞ The Animation Studio ..... 79.
4416 Sound Source ..... 29.

Quarterdeck ... NCP

6589 ☐ *DESQview/X 1.0*—A graphical, multi-tasking environment for DOS, Windows, and even UNIX. True "client/server" computing. Includes *Expanded Memory Manager 386* and *Manifest* ..... **$169.**

HARDWARE

Warranties listed next to manufacturer.

3 Com ... lifetime (conditional)

3453 EtherLink II/16 ..... 159.
3469 EtherLink II/16 TP ..... 169.

American Power ... 2 years

7108 Smart UPS 400 ..... 339.
7105 Smart UPS 600 ..... 439.
3819 Back-UPS 250 ..... 115.
3858 Back-UPS 400 ..... 179.
7107 Back-UPS 450 ..... 215.
3823 Back-UPS 600 ..... 295.

Appoint ... limited lifetime

2469 Thumbelina PC ..... 62.
2480 MousePen Pro PC ..... 62.

ATI Technologies ... 2 years

9821 VGA Basic-16 *(640 x 480, 16 colors)* ..... 65.
9985 VGA Integra *(1024 x 768, 16 colors)* ..... 84.
2706 VGA Wonder XL *(with 1 MB)* ..... 149.
2382 Graphics Vantage VGA *(with 1 MB)* ..... 225.
9822 8514/Ultra *(with 1 MB) (requires VGA)* ..... 399.
2012 Graphics Ultra with VGA *(with 1 MB)* ... 479.
9620 9600etc/e Modem ..... 285.
3902 Stereo•F/X *(sound board)* ..... 109.
3900 VGA Stereo•F/X *(w/512K, upgrd. to 1 MB)* 215.

Microsoft ... NCP

6195 ⊞ *Word 2.0 for Windows*—Everyday tasks are easy with the customizable toolbar, drag & drop movement of text, & instant character & page formatting from the Ribbon & Ruler. Includes drawing, charting & WordArt **$299.**

Boca Research ... 5 years

7150 BOCARAM/AT PLUS *(2 MB)* ..... 189.
7139 *(4 MB)* ..... 279. 7138 *(8 MB)* ..... 459.
6998 I/O Board for AT ..... 49.
6999 I/O Board for Microchannel *(S/S/P)* ..... 89.
8380 BasicVGA *(256K, 640 x 480)* ..... 49.
8381 SuperVGA *(1 MB, 1024 x 768)* ..... 115.
3859 2400 Internal Modem *(V.42, MNP Level 5)* 79.

Bravo Communications ... 2 years

7400 2 Position Laser Compatible Switch Box 109.

Brown-Wagh ... 1 year

8578 Creative Labs Sound Blaster ..... 109.
2336 Creative Labs Sound Blaster Pro ..... 189.

Caere ... 1 year

8158 Typist Plus Graphics ..... 389.

Canon ... 1 year

We are an authorized Canon Service Center.
7894 BJ-10ex Printer *(4.6 lb.)* ..... 329.
6679 BJ-20 Printer *(includes sheet feeder)* ... 429.
7897 BubbleJet Ink Cartridge *(BJ-10ex)* ..... 23.
7896 BJ-10ex Sheet Feeder ..... 75.

Cardinal ... 1 year

2719 MB2296SR Internal Send/Receive Fax .. 95.
1197 386-SX-25 Motherboard 0K ..... 239.
1480 Cardinal 9600 Internal Modem ..... 265.
2783 Cardinal 9600 External Modem ..... 299.

Chips & Technologies ... lifetime

6137 SuperMath 387DX-25 ..... 139.
6138 SuperMath 387DX-33 ..... 155.
6126 SuperMath 387SX-25 ..... 125.

CoStar ... 1 year

1947 LabelWriter II ..... 185.

COVOX ... 1 year

5543 Sound Master II ..... 145.

Curtis ... lifetime

1708 Ruby-Plus SPF-2+ ..... 59.
7358 Command Center SPF-4 ..... 85.

Cyrix Corporation ... 5 years

MATH COPROCESSORS
9875 FasMath 83D87-25 ..... 159.
9876 FasMath 83D87-33 ..... 169.
9877 FasMath 83S87-16 *(SX compatible)* ..... 99.
5551 ⊞ FasPro DX33 *(incl. Quattro Pro 3.0)* .. 215.
5552 ⊞ FasPro SX25 *(incl. Quattro Pro 3.0)* .. 215.

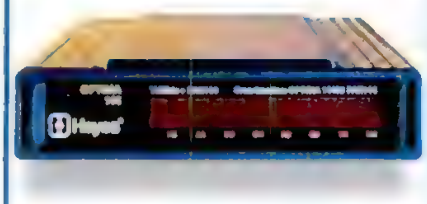
Diamond Computer ... 5 years

6945 Stealth Hi-Color ..... 265.
6947 SpeedStar Hi-Color ..... 175.
6946 SpeedStar 24 ..... 175.
6950 SpeedStar Plus 1M ..... 165.

Epson ... 2 years

We are an authorized Epson Serivce Center
5555 AP-3250 *(80 col., 200 cps, 24 pin)* ..... 239.
1906 FX-850 *(80 col., 264 cps, 9 pin)* ..... 319.
1904 FX-1050 *(136 col., 264 cps, 9 pin)* ..... 449.
2358 LQ-570 *(80 col., 252 cps)* ..... 289.
2361 LQ-870 *(80 col., 330 cps)* ..... 489.
2357 LQ-1170 *(136 col., 330 cps)* ..... 669.
5184 LX-810 *(80 col., 180 cps, 9 pin)* ..... 185.

that we ship



Hayes ... 2 years

7395 OPTIMA 144+ FAX144—Affordable V.32bis/14,400 bps data & Group 3/14,400 bps FAX. Sets best combination of speed, error control, & data compression, Includes free *Smartcom* data & FAX software ..... **$479.**

Hauppauge Computer ... 1 year

3670	33 MHz 486N Motherboard for AT *(1 MB)*	1229.
4008	Win/TV	439.

Hayes ... 2 years

7391	ULTRA 96 Modem	669.
5024	ULTRA 144 Modem	799.
1345	OPTIMA 24 Modem	155.
3522	OPTIMA 96 Modem	389.
7395	OPTIMA 144+ FAX 144	479.
9884	Pocket Edition 2400	119.

Hewlett-Packard ... 1 year

3175	DeskJet 500C *(color) (with toner)*	749.
3957	LaserJet IIP Plus *(with toner)*	879.
9993	LaserJet IIIP *(with toner)*	1099.
6754	LaserJet III *(with toner)*	1599.

Intel ... 3 years

3864	14.4EX Modem	469.
1086	Matched Memory Classic Memory Brd. 0k	139.
8903	Matched Memory 4 MB *(PS/2)*	189.
	Matched Memory *(for LaserJet IIP, III, IIIP, IIID)*	
1810	1 MB ..... 82. 1787 2 MB	145.
5990	SatisFAXtion Model 100	99.
5992	SatisFAXtion Model 200	299.
5994	SatisFAXtion Model 400	399.
5995	SatisFAXtion Model 400E	449.
5999	⊞FAXability Plus *(software)*	79.
6003	⊞FAXability Plus OCR *(software)*	165.
3076	Snap-In 386 *(for PS/2 50/60 & IBM AT)*	389.
2994	EtherExpress 16	129.
3021	EtherExpress 16 TP	129.
6413	OverDrive Processor *(for 486SX-20 MHz)*	459.
6418	OverDrive Processor *(for 486SX-25 MHz)*	579.
6251	NetPort II	499.
	MATH COPROCESSORS	
4750	80387SX *(16 MHz 80386SX CPU's)*	125.
6830	80387SX-20 *(20 MHz 80386SX CPU's)*	125.
5409	80387DX *(all 80387DX CPU's)*	209.

Kensington Microware ... 1 year

Full line available. Partial listing.

4973	PowerTree 20 *(6 outlets, EMI/RFI Filtering)*	24.
2582	Master Piece Plus 95. 2587 Remote	105.
7899	Expert Mouse *serial*... 99. 7900 *bus*...	115.
3311	MasterStand	59.
3312	LaserStand *(for HP LaserJet)*	125.

Keytronic ... 3 years

4518	101 Plus Keyboard	99.

Logitech ... limited lifetime

3996	Trackman2 *(combo)*	84.
2343	Trackman Portable	99.
7975	ScanMan 256	269.
3295	MouseMan *(combo)* 69. 9766 *(cordless)*	89.

MediaVision ... 3 years

5638	MultiMedia PC Upgrade Kit 16	$969.
5641	ProAudio Spectrum Plus	185.
5637	ProAudio Spectrum 16	219.

Megahertz ... 5 years

6576	P296FMV Fax Modem *(9600 baud V.42)*	479.
1187	T324FM 96/24 Fax Modem *(Toshiba Lptps.)*	269.

Microsoft ... lifetime

7597	Microsoft Mouse *(bus or serial)*	85.
2898	Mouse with Windows 3.0 *(bus or serial)*	149.
1896	Ballpoint Mouse *(serial only)*	119.

MicroSpeed ... 1 year

2763	MicroTRAC *(serial & PS/2 interface)*	57.
6330	PC-TRAC Trackball *(PS/2)*	75.
6007	PC-TRAC Trackball *serial*	75.
6008	PC-TRAC Trackball *bus*	89.

Microtek ... 1 year

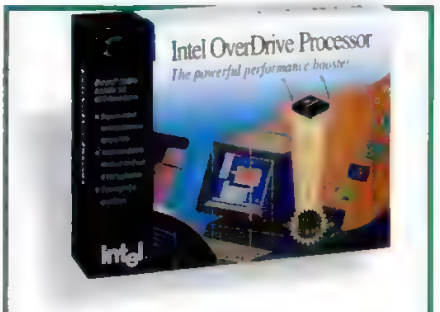
2736	ScanMaker 600G *(gray-scale scanner)*	759.
2739	ScanMaker 600Z *(color scanner)*	1249.

Mouse Systems ... lifetime

3213	PC Trackball II *(serial)*	55.
7878	PC Mouse III *(serial)*	69.
5613	Little Mouse/PC *(serial)*	65.
5979	NewPoint	79.

NEC ... 2 years

4252	MultiSync 3FGX Monitor *(14")*	689.
4249	MultiSync 4FG Monitor *(15")*	799.



Intel ... lifetime

OverDrive Processors—A revolutionary single-chip up-grade that can improve your overall i486 SX system performance by as much as 70%. Easy installation.

6413 *(20 MHz)* **$459.** 6418 *(25 MHz)* **$579.**

Okidata ... 1 year

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5093	OL400 Page Printer *(4 ppm)*	649.
5094	OL830 Page Printer *(8 ppm)*	1299.
3025	Toner Cartridge	25.

Orchid Technologies ... 4 years

7863	ProDesigner VGA IIS *(with 1 MB, includes RAMDAC chip)*	189.
4071	Fahrenheit 1280i with 1 MB	299.

Pacific Data ... lifetime/60 day MBG

5072	25 Cartridges in One! *(for DeskJet 500)*	105.
6779	25 Cartridges in One! *(LJ II, IID, IIP, III, IIID)*	269.
	Memory upgrade for LJ IIP, III, IIID, IIIP:	
7055	*2 MB* ..... 119. 7759 *4 MB*	199.

Canon ... 1 year

7894 BJ-10ex Printer—New enhanced version of the popular 4.6 lb. printer provides laser-like print quality (up to 360 dpi) on plain bond paper, envelopes or transparencies. Available in white or gray ..... **$329.**

Memory upgrade for LaserJet II/IID:

6838	*2 MB* ..... 145. 6836 *4 MB*	259.
7158	Pacific Page PE *(LJ IID, IIP, III, IIID, IIIP)*	299.
9833	Pacific Page XL *(w/accelerator board)*	699.
3388	Pacific Page PE w/ 2 MB *(LJ IIP, III)*	399.
5729	ProTracer *(personal CAD printer) (1 yr.)*	1099.

PC Power & Cooling ... 2 years

3203	Turbo Cool 200 *(power supply)*	149.
7915	Turbo Cool 300 *(power supply)*	159.

Practical Peripherals ... lifetime

3103	2400 Baud Internal Modem	79.
3102	2400 Baud External Modem	99.
8993	2400 Baud Internal Modem *(V.42 bis)*	115.
8994	2400 Baud Exernal. Modem *(V.42 bis)*	125.
8132	PM2400 Pocket Modem	109.
2266	PM9600 Internal Modem	275.
7934	PM9600SA Modem	289.
2264	PM2400FX96 *(int. modem/fax)*	95.
1344	PM2400FX96SA *(ext. modem/fax)*	99.
3803	PM14400FX96 *(int. modem/fax)*	359.
2425	PM14400FXSA *(ext. modem/fax)*	399.

Prometheus ... 2 years

1222	ProModem Ultima Home Office	489.

Selectek ... 1 year

4804	Pocket Fax Windows	219.
4769	Pocket LAN Ethernet	299.

Practical Peripherals ... lifetime

2425 PM14400FXSA Modem/Fax—Get ultra high speed 14,400 bps data transmission as well as Group III S/R fax capabilities in one integrated and affordable package. Includes *QuickLink II* for modem and fax communications **$399.**

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MMC

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Standard Microsystems ... 5 years

6376	Ethercard Plus 16	$149.
6370	Ethercard Plus 16T	165.

Targus ... lifetime

1305	Universal Notebook *(computer case)*	69.

Technology Concepts ... 2 years

6315	Fax Line Manager 203	139.
6009	OmniLink Laser	425.

TheComplete PC ... 2 years

6069	TheComplete Modem Plus	95.
5828	TheComplete Communicator	299.

Tripp Lite ... 2 years

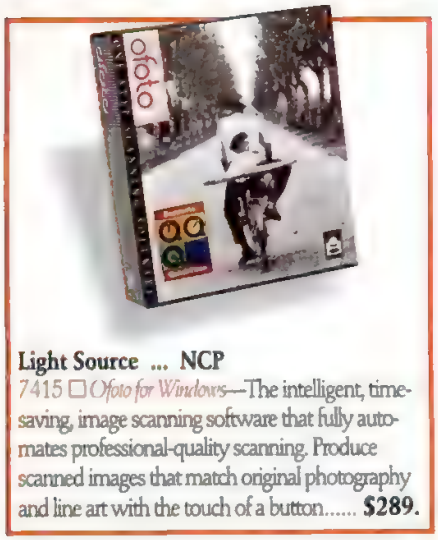
6199	Isobar 4-6 *(4 outlets, Gold Seal Warranty)*	49.
6200	Isobar 6-6 *(6 outlets, Gold Seal Warranty)*	59.
6506	BC1250 LAN Power Backup	499.

Video 7 ... 7 years

9768	VRAM II VGA 1 MB	329.

Zoom Telephonics ... 7 years

1307	Int. 2400 Baud w/9600 Baud Fax Modem	99.
1178	Ext. 2400 Baud w/9600 Baud Fax Modem	99.
1181	2400 Baud V.42bis Modem *(2 year)*	115.
3574	Ext. 2400 Baud V.42/9600 Baud Fax	145.
3386	FaxModem AFC *(2400 baud 96S/48R)*	69.
4430	FaxModem AFX *(2400 baud 96S/48R)*	79.
4429	FaxModem V.32bis 9600 baud *(internal)*	259.
4428	FaxModem V.32bis 9600 baud *(external)*	289.



Light Source ... NCP

7415 ☐ *Ofoto for Windows*—The intelligent, time-saving, image scanning software that fully automates professional-quality scanning. Produce scanned images that match original photography and line art with the touch of a button..... **$289.**

DRIVES

Colorado Memory Systems ... 1 year

4194	Jumbo 120 Tape Backup	199.
4354	Jumbo 250 Tape Backup	269.

Conner Peripherals ... 1 year

2339	CP30104 120 MB IDE HD *(19 ms)*	399.
1337	CP3204 200 MB IDE HD *(16 ms)*	599.

IOMEGA ... 1 year

We are an authorized Iomega Service Center.

6499	Transportable 90 PRO	679.
6501	Dual 90 PRO	1479.
6502	Insider 90 PRO	579.
6343	PC Powered 90 *(incl. PC2B & cart.)*	499.
6344	PC Powered 90 PRO *(incl. PC2B, cartridge & Central Point Software)*	599.
2500	PC2B-2 Controller	149.
2530	90 MB Cartridge	149.
2467	90 MB Cartridge Tripak	439.

Mountain Network Solutions ... 2 years

3812	FS8500 IDE Tape Backup *(304 M)*	499.
6153	DC2120 Tape Cartridge *(5 pack)*	149.

NEC ... 2 years

7020	Audio Upgrade Kit *(internal)*	399.
6577	CDR37 Portable CD-ROM Drive	399.
6582	CDR74 Portable CD-ROM Drive	589.
6581	CDR84 for PC/XT/AT	599.
7023	MPC Upgrade Kit *(with CDR37)*	949.
7022	MPC Upgrade Kit *(with CDR74)*	1149.
7021	MPC Upgrade Kit *(with CDR84)*	1079.

Pacific Rim ... 1 year

1304	1.2 MB External *(for any parallel port)*	$239.
2761	1.44EX MB Ext. *(for any parallel port)*	239.

Quantum ... 2 years

8304	Plus Hardcard II XL 50 MB *(9 ms)*	299.
8287	Plus Hardcard II XL 105 MB *(9 ms)*	449.
4060	105 MB Drive Kit for MC PS/2's *(13 ms)*	639.

Summit Memory Systems ... 2 years

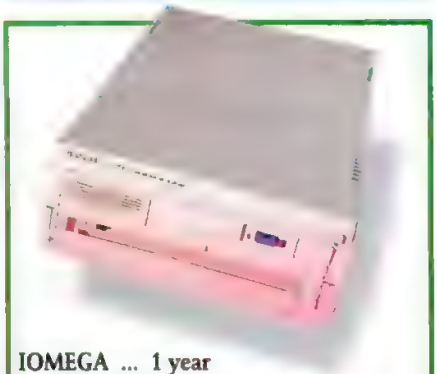
6436	SE120 Tape Backup	215.
6438	SE25 Tape Backup	285.

TEAC ... 1 year

6951	1.2 MB Drive for AT	65.
4670	1.44 MB Drive for PC/XT *(3½")*	59.
4326	1.44 MB Drive for AT *(3½", w/Bastech)*	79.
4951	720k Drive for PC/XT *(3½")*	55.
4414	3½ "/5¼ " Dual Floppy Drive	165.

Technology Concepts, Inc. ... 2 years

6315 *Fax Line Manager 203*—Share multiple communication devices on one phone line. Economical voice/data switch detects & routes voice calls, faxes & modem connections, with installation options for home/business use **$139.**



IOMEGA ... 1 year

6343 *PC Powered 90*—Lowest priced Bernoulli drive ever in one complete, convenient package. Includes 90 MB cartridge, PC2B interface card, and cable..... **$499.**

6344 *PC Powered 90 PRO* ..... **599.**

MEMORY

6556	256k DRAMs *(100 ns, set of 9)*	19.
5510	1 MB x 9 SIMMs *(80 nanosecond)*	45.
2497	4 MB x 9 SIMMs *(80 nanosecond)*	159.
5746	1 MB Chips *(80 ns, set of 9)*	45.

DISKS/MEDIA

3M ... lifetime

3943	DC2000	17.	1581 DC2120	23.

Fuji ... lifetime

2214	3½" DS Disks *(10)*	9.	2242 *(50)*	32.
2215	3½" HD Disks *(10)*	15.	2241 *(50)*	59.
2239	3½" HD Color Disks *(Qty. 10)*			18.
2243	3½" DS Color Disks *(Qty. 10)*			10.

Sony ... lifetime

3292	5¼" HD Disks *(Qty. 10)*			$11.
3297	3½" DS Disks *(10)*	9.	6148 *(30)*	25.
3298	3½" HD Disks *(10)*			15.
6375	3½" HD Disks *(30)*			42.
8185	QD2040 Tape Cartridge			14.
1895	QD2120 Tape Cartridge			21.
6715	QD6150	23.	1602 QD6250	29.

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Delrina ... NCP

5974 ☐ *DOSFax Pro 2.0*—Has many of the same features and ease-of-use that earned WinFax PRO 3 industry awards in 1991. Fax documents from any DOS application. Works with any SendFax, Class I or Class II compatible fax modem **$49.**

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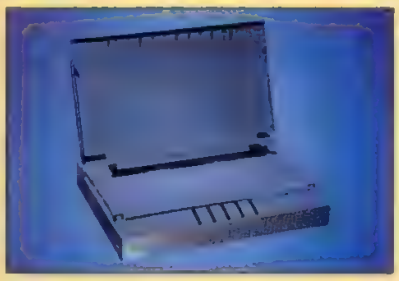


FACT FILE

Canon BJ-10ex Bubble Jet Printer
Canon USA Inc., One Canon Plaza, Lake Success, NY 11042; 800-848-4123, 516-488-6700

List Price: $499 (includes AC adapter/charger, power and connecting cables, and one ink cartridge) Nickel cadmium battery, $50, 220V 50Hz adapter, $50, 240V 50Hz adapter, $50, 30-page sheet feeder, $90, extra ink cartridge, $25; carrying case, $59 95

Requires: Parallel port

Dimensions (HWD): 1.9 x 12.2 x 8 5 inches, 4 2 x 12 2 x 8.5 inches with sheet feeder

Weight: 4.0 pounds, 4.6 pounds with battery, 5.3 pounds with battery and AC adapter

Emulations: Epson LQ-510, IBM Proprinter X24E, and Canon BJ-130e

In Short: A former Editors' Choice winner, the Canon BJ-10ex Bubble Jet Printer features good speed and quality text output The best way to choose between the Canon BJ-10ex and its near twin, the Brother HJ-100i Ink Jet Printer, is by street price

952 ON READER SERVICE CARD

vide quiet operation and a 360-by-360 dpi resolution, which helps account for the excellent text output. Graphics output for both printers, on the other hand, was adequate rather than excellent.

Both printers support 8.5-by-11-inch, A4, and legal-size paper, as well as envelopes. We were also able to print on transparencies, though neither printer claims support for them. Both printers exhibited problems with paper handling using the optional sheet feeder, however. The printers do not support continuous form paper, and the sheet feeder caused both printers to pull two or three sheets through at a time and jam. Neither company could explain this problem. It may be easier to hand-feed single sheets of paper and not worry about the sheet feeder.

The two printers provided comparable speed results on our Epson emulation tests, with the Brother HJ-100i doing slightly better than the Canon BJ-10ex in both text and graphics modes. On our text and graphics tests, the Brother HJ-100i rated 42 cps and 1.40 gppm, respectively, compared with the Canon BJ-10ex's scores of 39 cps and 1.30 gppm. In fact, the Brother HJ-100i was the fastest graphics performer of this roundup using the Epson emulation. Using their IBM emulations, the Canon BJ-10ex bested the Brother HJ-100i on graphics speed: The Canon BJ-10ex scored 0.80 gppm to the Brother HJ-100i's 0.70 gppm.

While not the most compact devices, both the Canon BJ-10ex Bubble Jet Printer and the Brother HJ-100i Ink Jet Printer have the speed and quality text output to serve on the desktop as well as on the road. Since both companies offer comparable service and support, the real factor in choosing between these printers will be the street prices that you find.

Citizen America Corp.

Citizen PN48 Notebook Printer

BY MITT JONES

Feel up to a challenge? First, set the $469 Citizen PN48 Notebook Printer next to a page of its own output, mixing text and

AC Etiquette Abroad

by Tom Unger

Before taking your new portable printer overseas, you'll want to check which voltage and Hertz ratings its AC adapter supports. While North America has standardized on 110-volt/120-volt 60-Hertz outlets, other countries present a bewildering spectrum of voltages and Hertz ratings (see the table "International Voltage and Outlet Plug Guide" that appears elsewhere in this issue).

The current from a wall socket is measured in three ways: *voltage*, which is analogous to the water pressure in a pipe; *amperage*, akin to the amount of water flowing through the pipe; and *frequency* or *Hertz*, the rate at which the flow of power changes direction (measured in cycles per second).

Most portable printers' AC adapters cannot handle wide voltage variations. A printer using a 110V/120V-only adapter that is plugged into a 220V outlet will likely fry.

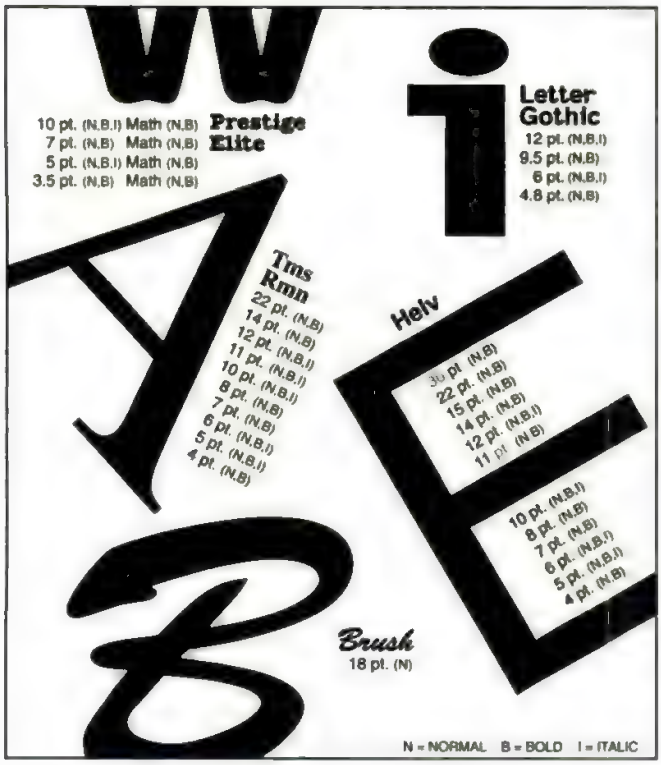
Don't assume you can get around these troubles when traveling overseas by hooking your portable printer up to a hotel outlet offered for U.S.-style electric razors. While the outlet may provide the right voltage and frequency ratings, it often lacks the amperage to fully power a printer operating with a 110V/120V 60-Hz adapter. Your printer's innards are optimized to run at a specific amperage; anything below that may cause a printer brownout. At best you will get garbled output; at worst, you will damage the printer's delicate timing mechanisms.

A final problem is with frequency. A cheap voltage converter (available from most electronics stores or from in-flight catalogs) may adapt a 220V outlet to 110V or 120V, but it won't affect the frequency. An adapter designed for 60-Hz AC current may produce power fluctuations at 50 Hz; this might damage a printer's motor and gears. Operating your printer on an outlet that provides power at the wrong frequency may also void the warranty that comes with your printer.

If you don't want to be limited to carrying spare batteries, consider the options. The Toshiba ExpressWriter 201's adapter supports from 100V to 240V, at 50Hz to 60HZ. The Citizen PN48 has an optional 220V 50-Hz adapter ($79). (As with most laptops, both units use a specific power cord for a given country's outlet socket.) Both Kodak and Canon offer 220V 50-Hz and 240V 50-Hz adapters for their printers.

The best way to avoid unpleasant shocks is to call the manufacturer *before* you buy and ask where you can and cannot plug in its portable printer, and what, if any, optional equipment you'll need. □

How to put all of these in your DeskJet printer,



and keep more of these in your pocket.

When you want just the right fonts for both personal and business documents, turn to 25 in One!™ for DeskJet, the all-in-one printing solution from Pacific Data Products.

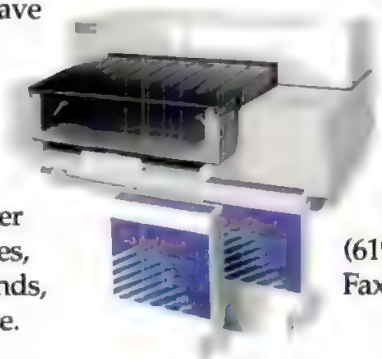
The 25 in One! for DeskJet package comes in two versions, one for the HP DeskJet Plus and the other for the HP DeskJet 500/500C*. Each version contains two megafont cartridges with all the high-quality bitmapped fonts you need for your word processing, spreadsheet, and desktop publishing applications. And since 25 in One! for DeskJet offers fonts that would require you to purchase seven HP DeskJet cartridges, you'll save something besides just shelf space ...like CASH!

The suggested retail price for the HP DeskJet Plus or 500/500C version of 25 in One! for DeskJet is only $149 — a substantial savings over having to purchase separate cartridges, whether you count it in Dollars, Pounds, Francs, Marks, Lira, or something else.

And 25 in One! for DeskJet includes 11 and 22 point fonts not offered in the HP cartridges.

25 in One! for DeskJet contains the most popular typefaces, including Tms Rmn, Helv, Prestige Elite and Letter Gothic, as well as the full Roman 8 and Math symbol sets. And it's compatible with the popular WordPerfect 5.1, Microsoft Word 5 and 5.5, Microsoft Windows 3.0, and WordStar 6.0 software applications.

So if you're looking for more fonts for your HP DeskJet Plus or 500/500C printer, call your nearest dealer and ask for the low-cost, easy-to-use solution, 25 in One! for DeskJet.



For information on our other popular, cost-effective laser printer enhancement products, contact Pacific Data Products, Inc., 9125 Rehco Road, San Diego, California 92121, U.S.A.
(619) 597-4679
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PACIFIC DATA PRODUCTS

Fonts displayed in the illustration above are from both versions of 25 in One! for DeskJet. The font selection for each version varies slightly.

* 25 in One! for DeskJet is compatible with the DeskJet 500C only when used with a black ink cartridge.

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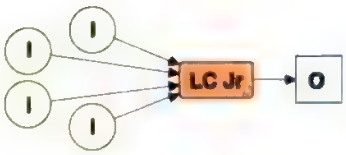
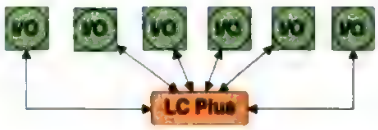
Printer Sharing

= PARALLEL DEVICE = SERIAL DEVICE = PARALLEL OR SERIAL DEVICE I = INPUT FROM PC O = OUTPUT TO PERIPHERAL



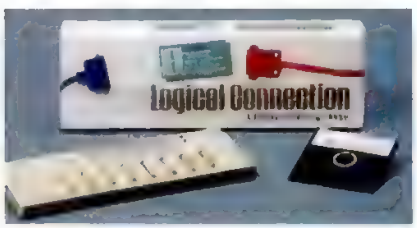


LC Jr.-256Kb $239

Serially connect up to four PCs to the **Logical Connection Jr.** at speeds up to 115,200 bps. It will automatically convert the data for easy sharing of one parallel printer.

LC-512Kb $495

The **Logical Connection** has eight ports: four bi-directional serial ports which can be set as input or output, two parallel inputs and two parallel outputs.



LC Plus-512Kb $695

All six ports of the **Logical Connection Plus** are automatically configured as parallel or serial, and input or output. Versatility and high speed are key features.

- **UL Listed Power Supplies**
- **FCC Class B Certification (LCJr. - A)**
- **Fast Data Input and Throughput**
- **Socketed DRAM Upgrades to 1Mb**
- **Largest Selling PSDs in the USA**

Logical Connections allow several users to easily share expensive printers and other resources. Choose the peripheral that you need with a pop-up menu or ASCII string.

Multiple users can send data simultaneously since Logical Connections with memory will buffer and queue jobs on a first-in-first-out basis. A 256Kb buffer will hold up to 100 pages of text or about 5 - 10 pages of graphics data.

If your company has a LAN, use Logical Connections for local printer sharing in smaller workgroups, rather than printing centrally through the LAN. Local printing is more convenient and more secure!

LC -41PAS $100

Smart switch to automatically connect up to 4 parallel inputs to 1 parallel output.

SPPS $60

Serial/Parallel or Parallel/Serial converter, no power supply required.

Logical Connection, Inc.
4660 Portland Road NE #108, Salem, OR 97305
FAX: (503) 390-9372
Tech. Support: (503) 390-9375

LOGICAL CONNECTION 800-238-9415 US & Can.

Laptop Memory

Macintosh Powerbook 100

(Dealer must install)

Memory Module	EPB-2000	2 Mb	CALL
Memory Module	EPB-4000	4 Mb	CALL

Macintosh Powerbook 140/170

(Dealer must install)

Memory Module	EPC-4000	4 Mb	CALL
Memory Module	EPC-6000	6 Mb	CALL

Toshiba Laptop Models:

(User may install)

1000SE/XE/LE, 2000, 2000SX
2000SXE, 2200SX (exclude 1Mb)

Memory Card	RCT-1000	1 Mb	CALL
Memory Card	RCT-2000	2 Mb	CALL
Memory Card	RCT-4000	4 Mb	CALL
Memory Card	RCT-8000	8 Mb	CALL

PC-MCIA 2.0 / JEIDA SRAM

(User may install)

For Laptops conforming to this new universal spec.

Memory Card	RJB-0512	512 Kb	CALL
Memory Card	RJB-1000	1 Mb	CALL
Memory Card	RJB-2000	2 Mb	CALL

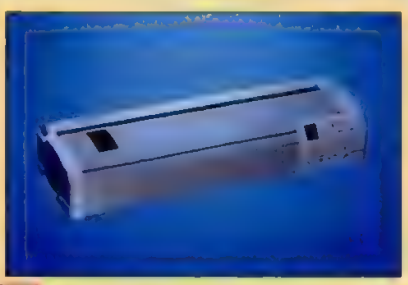
CIRCLE 131 ON READER SERVICE CARD

graphics as you please. Then round up a cynical coworker or two and just try to convince them that such dark, crisp output came from so compact a printer.

Based on thermal-fusion technology, the 360-dpi Citizen PN48 matches or betters the print quality of most 300-dpi desktop lasers: Its blacks print solid and deep, even on laser transparencies. With text, the printer produces character edges nearly as smooth as those from lasers. Dithered graphics look remarkably good in either the Epson LQ or 24-pin IBM Proprinter emulation, marred only by the faintest of black registration lines. (The unit also offers a native emulation mode.)

Citizen America Corp. packaged these capabilities in a 2.0- by 11.7- by 3.5-inch (HWD) case, small enough to slip into a briefcase alongside a laptop PC. The printer, a former *PC Magazine* Editors' Choice (reviewed in "Dot Matrix: Quietly Evolving," November 26, 1991), weighs 2.2 pounds with its ribbon cartridge installed. The 0.4-pound nickel cadmium battery provides 25 or so pages of outlet-free operation with each 6-hour charge. Adding the 0.3-pound proprietary parallel cable and the 110-volt 0.6-pound AC adapter/charger brings the total weight to 3.5 pounds, a small burden for such high-quality output.

Other strengths of this printer include an automatic paper feed, a second, straight-through paper path for envelopes and heavier stock, and quiet operation. A 1-character LED display helps users navigate the control-panel configuration menu.



FACT FILE

EDITORS' CHOICE

Citizen PN48 Notebook Printer

Citizen America Corp., 2450 Broadway, #600, Santa Monica, CA 90404-3060; 800-477-4683; 310-453-0614; fax, 310-453-2814

List Price: $469 (includes 110V AC adapter/charger, connecting cables, and one multistrike ink cartridge) Professional package (includes nickel cadmium battery, one single-strike ink cartridge, and soft carrying case), $549 Nickel cadmium battery, $95, 220V 50Hz AC adapter/charger, $79, cigarette lighter adapter, $59, extra ink cartridge, $4.99, soft carrying case, $29, deluxe carrying case, $49

Requires: Parallel port

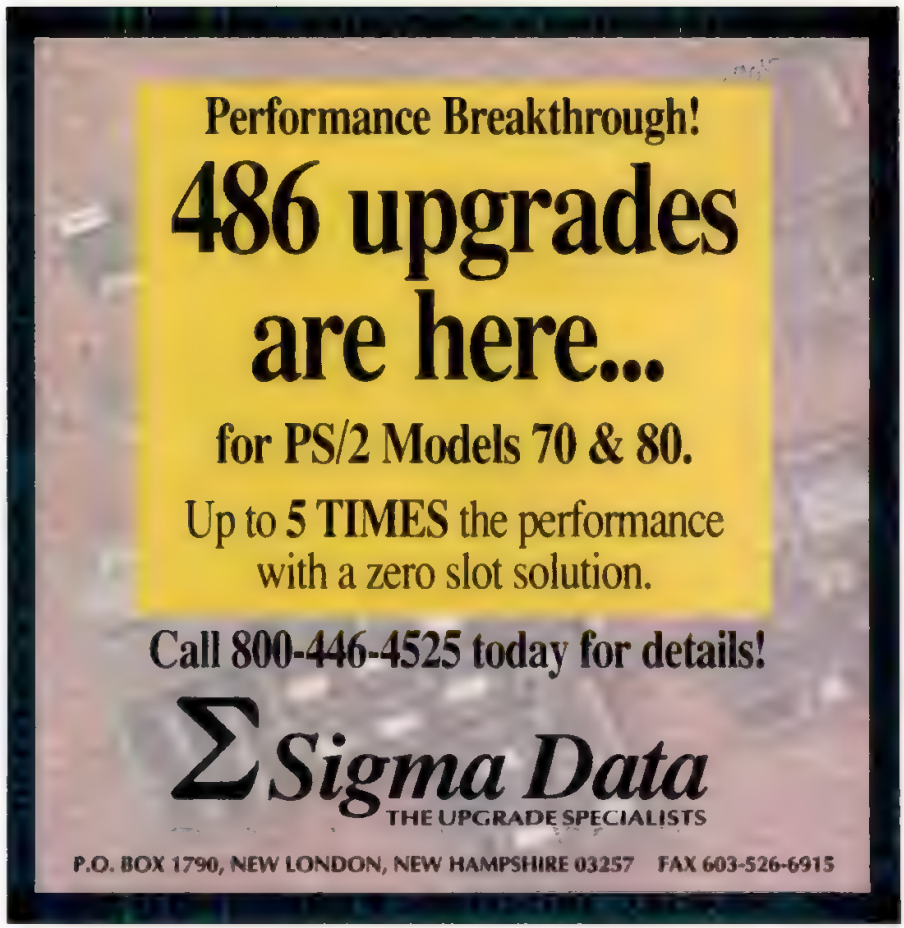
Dimensions (HWD): 2.0 x 11.7 x 3.5 inches

Weight: 2.2 pounds, 2.6 pounds with battery, 3.2 pounds with battery and AC adapter

Emulations: Epson LQ, IBM Proprinter X24, and Citizen GSX

In Short: The amazingly compact, thermal-fusion Citizen PN48 Notebook Printer rivals the print quality of desktop lasers. For high-quality, cut-sheet output in a truly portable package, look here first

553 ON READER SERVICE CARD



CIRCLE 213 ON READER SERVICE CARD

NOT QUITE A LASER

The Citizen PN48 easily beats other portables when it comes to print quality, though it falls short of desktop lasers. For example, a closer look at the 12-pitch Courier reveals some roughness. And while the Roman typeface should prove passable for most users, it looks thin next to a high-quality laser Roman typeface. In both cases, the printer merely eliminates the white space between 12-point characters to produce 12-pitch fonts.

Of course, those who shrink from feeding cut sheets one page at a time should look elsewhere, as should those who must print on continuous forms. The Citizen PN48 provides no tractor-feed pins and does not expressly support continuous forms. For our speed tests, however, we fed edgeless continuous forms to the printer and noticed a tendency to overheat. A Citizen spokesperson reported that removing the battery pack during AC operation should solve this problem.

Citizen PN48 Notebook Printer

Courier
Get your facts first

Roman PS
Get your facts first

The Citizen PN48 won't bowl you over with its speed, but it did outpace the slowest portable tested here. The Citizen

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CIRCLE 135 ON READER SERVICE CARD

PN48, which prints letter-quality text only, clocked in at 24 cps in both emulations on our text test. On our graphics test, the printer scored 0.50 gppm and 1.00 gppm for IBM and Epson emulations, respectively.

With the $4.99 single-strike ribbon, the Citizen PN48 operates at a hefty 36 cents a page. With the multistrike ribbon (also $4.99), per-page costs will drop if you reuse the ribbon.

The Citizen PN48 ships in two configurations. The $469 standard package consists of the printer, an AC adapter, a parallel cable, and one multistrike ribbon. The $549 Professional System adds the slim battery pack ($95), the soft carrying case ($29), and an extra single-strike ribbon. The Professional System's street price runs as low as $400.

The Citizen PN48 Notebook Printer's manual-feed requirements make it less than ideal for most desktop applications, but this printer provides a strong solution for those who need truly portable cut-sheet printing. The Citizen PN48 also offers the highest possible text and graphics quality from a portable printer for any application.

Digital Equipment Corp.

DECjet 1000

BY BILL DYSZEL

At $329, Digital Equipment Corp.'s DECjet 1000 is the least expensive printer reviewed here—and the least portable. Unlike the other printers in this review, the DECjet does not provide a battery option. And at 4.5 by 13.5 by 5.8 (HWD) inches and 6.4 pounds without any options, the unit is too bulky for constant on-the-road use.

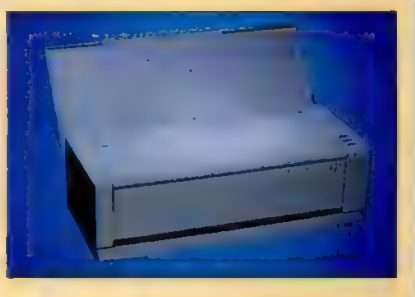
The AC-only DECjet is more transportable than truly portable. It is perhaps best suited as a desktop device that can be taken on the road by the occasional traveler. In fact, a DEC spokesperson said that the DECjet is intended to compete primarily with the HP DeskJet, rather than the smaller printers from Citizen or Kodak.

The only internal emulation available is HP DeskJet; Epson and IBM emulations require expansion cards ($149 each). But there is only one expansion card slot: You must choose among adding one of the emulations, one of Digital Equipment's optional $99 font cards, or memory beyond the 8K built in (up to 256K for $199).

RATING THE OUTPUT

The DECjet 1000 produces dark, clear print at 300-dpi resolution—at least for text. Graphics output, however, suffers from obvious jaggies and is too dark for most uses. In addition, the DECjet printer uses a water-based ink that tends to smear when first printed and when moistened. The printer comes equipped with internal Courier, Gothic, and Times Nordic fonts.

The paper-handling logic for this cut-sheet printer is peculiar, requiring a manual form feed after every page. But the DECjet still had the highest speeds in quality printing: 49 cps in both emula-



FACT FILE

DECjet 1000

Digital Equipment Corp., 146 Main St., Maynard, MA 01754-2571; 800-344-4825, 508-493-5111; fax, 800-234-2298

List Price: $329 (includes power cable and one ink cartridge). 70-page sheet feeder, $99; IBM Proprinter or Epson FX-850 emulation card, $149; connecting cable, $34; extra ink cartridge, $50; additional font card, $99

Requires: Parallel port.

Dimensions (HWD): 4.5 x 13.5 x 5.8 inches, 10.8 x 13.5 x 14.2 inches with sheet feeder

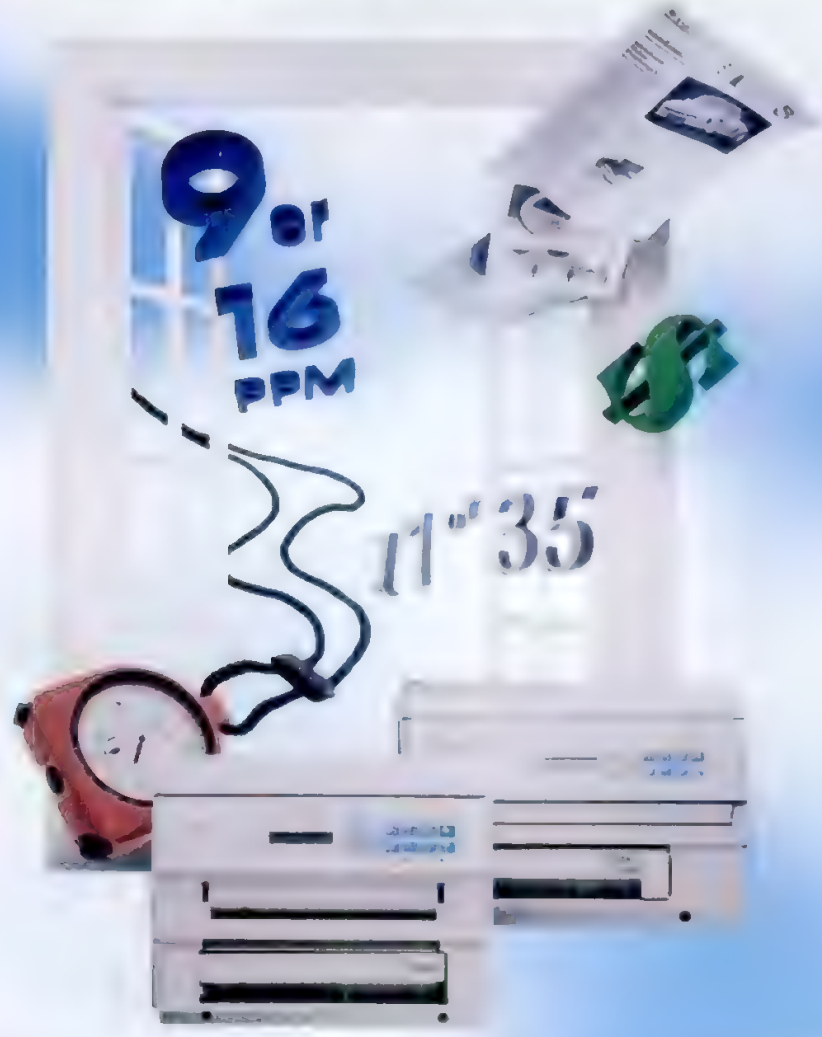
Weight: 6.4 pounds

Emulations: Epson FX-850, IBM Proprinter, and HP DeskJet

In Short: Digital Equipment Corp.'s DECjet 1000 is an AC-only printer that provides good text print quality and speed. But the machine's appeal is limited by many restrictions, including a lack of technical support for users who don't purchase the extended warranty or a PC with their system

554 ON READER SERVICE CARD

Four reasons to buy a TI microLaser™ printer.



Now there's a way for you to put the power of Microsoft® Windows™ on paper – microLaser from Texas Instruments.

Designed to be Windows-compatible, there's a microLaser just right for your needs, whether you need a personal or shared printer. Here's why:

MacUser ★★★★½

1. Compatibility With HP LaserJet® emulation and Adobe® PostScript® software, microLaser easily supports your demanding applications. And with our Microsoft Windows driver, set it and forget it with all Windows applications.

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2. Performance When it comes to printing high-quality documents fast, microLaser really makes you look good. At either nine or 16 pages-per-minute, microLaser printers speed you through documents in a hurry. Plus PostScript means what you see on your screen is what you get on paper. You can even turbocharge your microLaser with a RISC processor for blazing fast graphics.

POSTSCRIPT® Software From Adobe

3. Reliability When you buy a printer, you want it to print. And print. And print. That's just what the microLaser does.

Take our personal microLaser Plus for example. With its high duty cycle of 10,000 pages-per-month* and a standard one-year limited warranty**, you can rely on your microLaser to work the first time, every time, for years.

4. Value Starting as low as $999†, there's a microLaser designed to fit any budget. From the single user all the way up to a network. Consider this, too: microLaser's average cost per page is only 1.9 cents‡, while some laser printers average around 3.3 cents. The microLaser not only makes sense, it saves you money, too.

For details on the right microLaser for you and the name of the nearest dealer, call

1-800-527-3500.

Features	microLaser Plus Basic	microLaser Plus PS17/PS35	microLaser Turbo	microLaser XL Turbo
PPM	9 ppm	9 ppm	9 ppm	16 ppm
Emulation	HP LaserJet II	HPLJII/PostScript	HPLJII/PostScript II	HPLJII/PostScript II
Processor	68000	68000	RISC/8220	RISC/8220
Fonts	14 HP Fonts	17 or 35 Scalable	35 Scalable	35 Scalable
List Price	$999	$1,399/$1,749	$2,249	$3,649

The microLaser PS17 has earned the 1990 *PC World* Best Buy award; microLaser PS35 has earned the 1990 *InfoWorld* Excellent Value award and 4½ mice from *MacUser*, October 1990.

TEXAS INSTRUMENTS

*Based on estimated typical usage. **For more information on service upgrade options, call 1-800-847-5757 in the U.S. and 1-800-268-6314 in Canada. †Suggested retail price – dealer prices may vary. ‡Based on suggested retail price of consumables and approximate page coverage rating for each consumable at 4% black (toner, developer and OPC). microLaser is a trademark of Texas Instruments Incorporated. Microsoft and DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. LaserJet is a registered trademark of Hewlett-Packard, Inc. Apple and Macintosh are registered trademarks of Apple Computer, Inc. OS/2 is a registered trademark of International Business Machines Corporation. UNIX is a registered trademark of AT&T. ©1992 TI 76518

CIRCLE 353 ON READER SERVICE CARD

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Isn't Capitalism Cool?

Where else but in the land of the free and the home of high technology could you find the leader in OCR also offering the lowest prices? Where else could you, the customer, come up such a clear winner? ▲ Look no further than WordScan™ and WordScan Plus, now at their newly reduced suggested retail prices ($295 and $695 respectively). Costing $300 to $400 less than the competition, both offer the industry's most accurate OCR (per a university study), exceptional features and ease-of-use. Providing a better way to get information in any form — *electronic images, faxes or paper* — into your favorite computer applications. ▲ In fact, the last time OCR was reviewed, *PC Magazine*, *PC Week*, *InfoWorld* and *Byte* made comments like *"sets a new standard"* (ditto for our 1991 MacUser Eddy Award on the Macintosh side). ▲ The conclusion: WordScan Plus clearly tops OmniPage® Professional with Style Sheets and Templates. As well as superior one-step processing to avoid multiple settings. Both WordScan products provide omnifont technology to handle virtually any business font or type (**bold**, *italic*, underlining). Along with Deferred Processing to optimize computer time. And they fully support HP AccuPage technology for the ScanJet II Series. ▲ So why is so much now available for so little? We can only reply that in these days of Wal-Mart and Price Club, cost is no measure of quality. Indeed, if these reductions lead to the best in OCR becoming truly affordable for any computer user, then both the mandates of the marketplace and the dictates of capitalism will be satisfied. And to that we can only add hooray for the red, white and blue!

A penny saved is a penny earned. Buy WordScan Plus before October 30, 1992 and we will reward you with a crisp Ben Franklin. (Or its $100 equivalent.)*

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CIRCLE 053 ON READER SERVICE CARD

If You Can't Take It With You

by Tom Unger

Even if you can't justify purchasing a portable printer, it's likely that at some point, you will need to get printed output when you're on the road. Here are some alternative means of doing so.

• *Fax it:* If your portable computer has a fax/modem, hard copy is as close as your hotel's fax machine. But some hotels charge up to a dollar *per page* for delivery. Fax several documents each day and you may find that a portable printer is cheaper. Ask in advance what your hotel charges.

Also remember that you won't be the only one using the hotel's fax machine; you may end up waiting some time before your document can be sent. One technique that seasoned travelers use: Fax at night when offices are closed and fax traffic is light.

• *Modem it:* Your standard modem can't send faxes, but you can use an e-mail service such as MCI Mail, AT&T EasyLink, or CompuServe to send yourself a fax. If you're not near a fax machine, consider using your e-mail service's priority mail facility to mail yourself laser hard copy. This can be expensive, however, and usually works only in major metropolitan areas. Moreover, these services reproduce naked ASCII text, *sans* formatting commands such as underlining or boldface.

• *A borrower be:* If you must use someone else's laser printer, Computer Communications Solutions (800-321-0713) offers an easy-to-coil, 3-foot, 0.25-pound parallel Centronics cable for under $10. Plugging your own cable into the back of the printer is easier and less intrusive than unhooking the parallel cable from the other user's PC.

• *Stockpile drivers:* Above all, make certain you have drivers for the HP LaserJet II, the Epson FX/MX, and the Apple LaserWriter for *all* your applications. For applications that can't be saved as DOS text output, try a TTY (teletype) driver for telex-like output: straight ASCII code with line feeds. Nothing can be more frustrating than obtaining access to a printer you can't use because your laptop lacks the proper driver. □

tions. Its draft text score of 69 cps in Epson emulation was also impressive. On the graphics test, however, the DECjet scored a weak 0.50 gppm in Epson emulation. Its performance on the graphics test in IBM emulation was a little better, at 0.70 gppm.

Digital Equipment sells a 70-page sheet feeder ($99), which the company did not submit for this review. The sheet feeder might solve the printer's paper-handling problems, but it also adds another 2.9 pounds (for a grand total of 9.3 pounds). The printer does not work with continuous form paper, though it can handle heavier stock, envelopes, and transparencies.

With the $19.95 cartridge, the DECjet prints letter-quality pages for a low 10 cents a page, or 5 cents a page in draft mode because less ink is used. But don't expect a break from the already low $329 price; the DECjet is sold through the company's new direct retail channel.

DECjet 1000

Times Nordic
Get your facts first

Letter Gothic
Get your facts first

Courier
Get your facts first

One major drawback is the printer's warranty: Unless you buy an extended warranty (for a total of $495) or a PC with the DECjet, there is no official technical support. With the extra purchase, however, you get 24-hour technical support, 7 days a week.

The best thing about the DECjet 1000 is its text-printing speed. It's up to you to decide whether being able to print that quickly justifies the tradeoffs you'll have to make.

CALERA FAXGRABBER

$99

Very Cool.

And while we celebrate free enterprise, we also applaud its result: innovation. By example, we cite FAXGrabber™, the first fax-conversion Windows utility, for your PC fax card (now only $99, normal price is $149). It turns a static computer fax image into editable text. ▲ *PC World* says "*if you receive a lot of PC faxes you'd like to manipulate...(it) can make your life a lot easier.*" And *Home Office Computing* explains why: "*the utility automatically—and in the background—converts the fax into text; launches into an application (so you can work with it); saves the text into a file; or, places the text directly onto the Windows Clipboard... these features seem to make FAXGrabber almost indispensable....*" ▲ Thus, a remarkable demonstration. The value of capitalism and innovation, all supported by the power of a free press. Call 1-800-4-FAX-GRAB to order today.

CALERA
RECOGNITION SYSTEMS

Works with all leading fax cards. FAXGrabber is a trademark of Calera Recognition Systems ©1992 Calera Recognition Systems, Inc. All other trademarks are property of their respective holders.

CALERA FAXGRABBER

CIRCLE 041 ON READER SERVICE CARD

How to Read the Printer Guide

● Text Speed
Our Text Speed test is a two-page business letter, and results are reported in characters per second (cps).

Graphics Output
The photo shows how well the printer reproduces halftones.

Gray-Scale
This bar consists of six shades of gray.

Text Output
We have enlarged the letter P to nearly ten times its original size so that you can clearly see the way the printer handles straight lines and curves for text.

Line Art
This test indicates how well the printer handles curved lines, as well as lines of various widths.

● Graphics Speed and Graphics Time
Results for outputting the scanned photo are given both in graphics pages per minute (gppm) and in minutes and seconds.

BROTHER HJ-100i INK JET PRINTER — $499

64-nozzle ink jet printer

EPSON EMULATION:
- ● **Quality Text Speed:** 42 cps
- ● **Graphics Speed:** 1.4 gppm
- ● **Graphics Time:** 0 min 44 sec

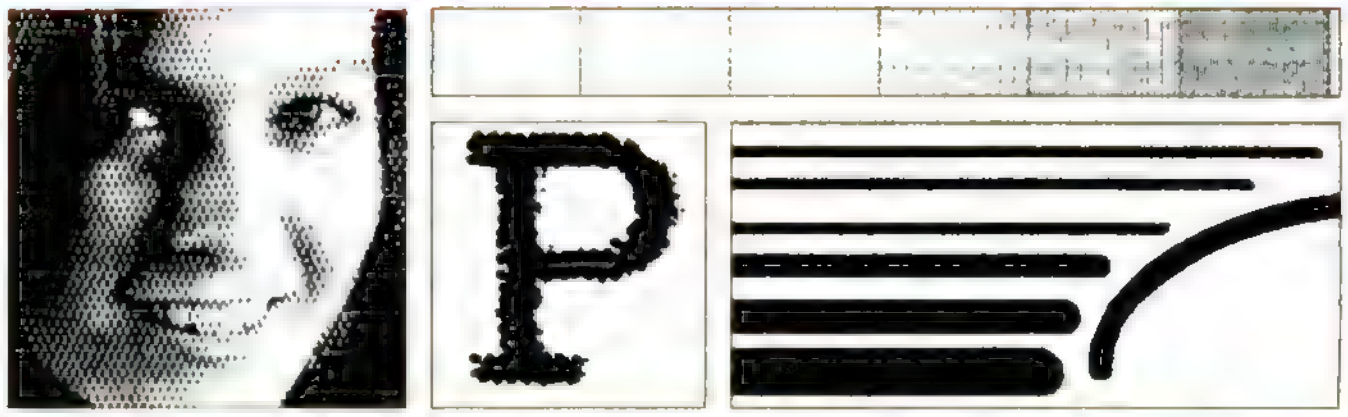
IBM EMULATION:
- ● **Quality Text Speed:** 42 cps
- ● **Graphics Speed:** 0.7 gppm
- ● **Graphics Time:** 1 min 21 sec

CANON BJ-10ex BUBBLE JET PRINTER — $499

64-nozzle ink jet printer

EPSON EMULATION:
- **Quality Text Speed:** 39 cps
- **Graphics Speed:** 1.3 gppm
- **Graphics Time:** 0 min 46 sec

IBM EMULATION:
- **Quality Text Speed:** 42 cps
- **Graphics Speed:** 0.8 gppm
- **Graphics Time:** 1 min 20 sec

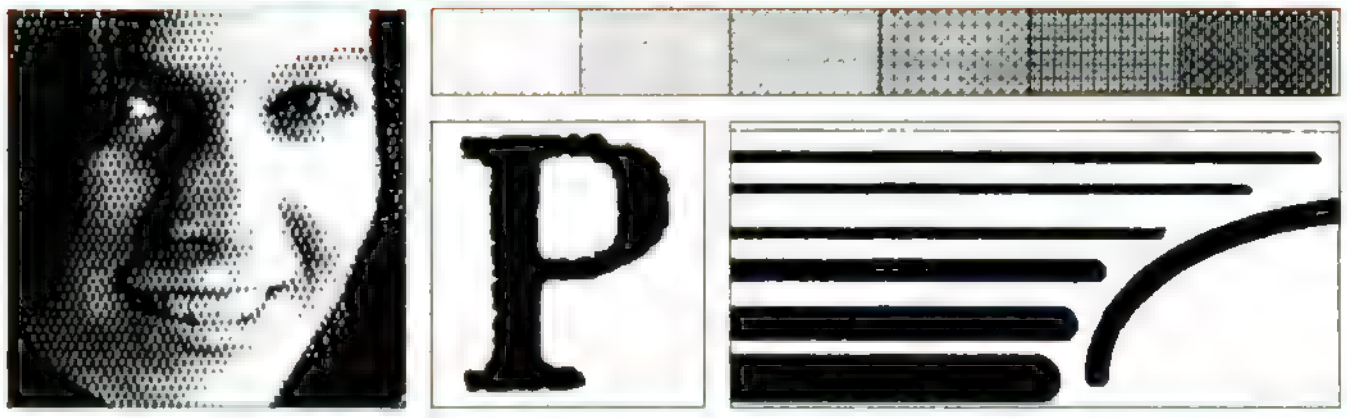


CITIZEN PN48 NOTEBOOK PRINTER — $469

48-pin thermal fusion printer

EPSON EMULATION:
- **Quality Text Speed:** 24 cps
- **Graphics Speed:** 1.0 gppm
- **Graphics Time:** 1 min 2 sec

IBM EMULATION:
- **Quality Text Speed:** 24 cps
- **Graphics Speed:** 0.5 gppm
- **Graphics Time:** 1 min 49 sec

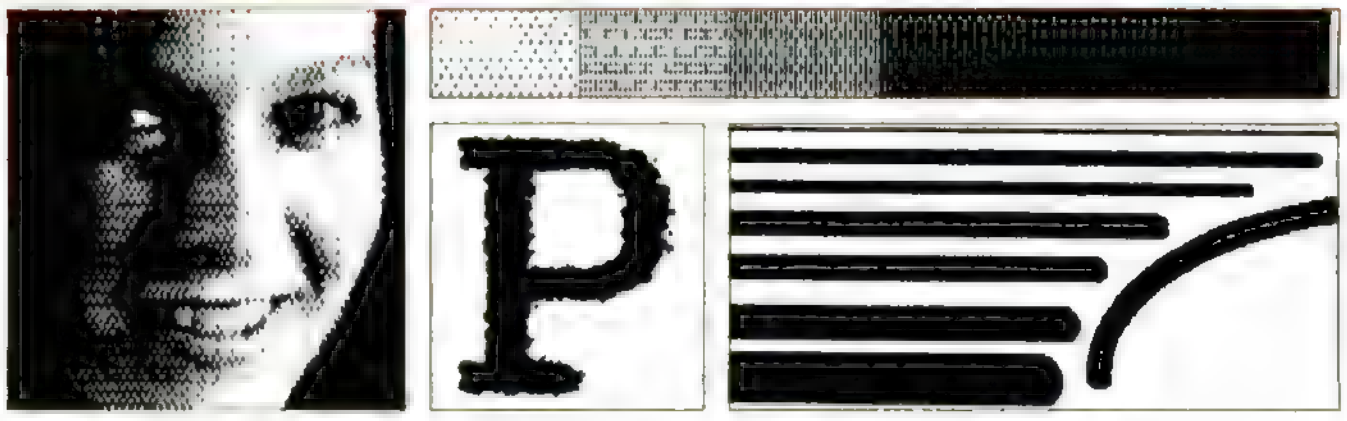


DECjet 1000 — $329

50-nozzle ink jet printer

EPSON EMULATION:
- **Draft Text Speed:** 69 cps
- **Quality Text Speed:** 49 cps
- **Graphics Speed:** 0.5 gppm
- **Graphics Time:** 2 min 7 sec

IBM EMULATION:
- **Draft Text Speed:** 65 cps
- **Quality Text Speed:** 49 cps
- **Graphics Speed:** 0.7 gppm
- **Graphics Time:** 1 min 32 sec



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achine were designed especially for me!" she smiles, ith her head in the clouds. "The HandBook is so small d feather-light; yet it has a truly usable keyboard and splay, a real hard drive, and the capability to transfer es back to my editor. I can travel with it and not even own I'm carrying it!"

"Once again, Gateway is in the pilot's seat," Dakota lds. And, as he and Lexa fly off into the wild blue nder with their message, we know in our hearts that e saga of Gateway 2000 will continue....

GATEWAY2000

You've got a friend in the business.

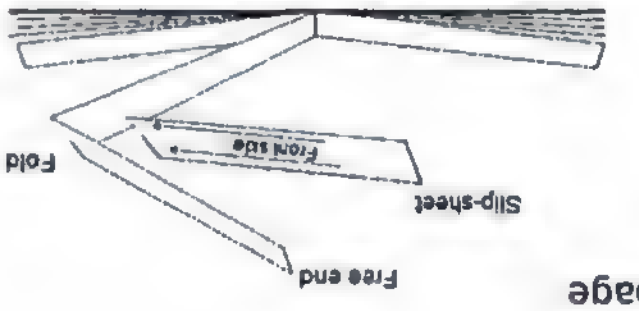
8 0 0 - 5 2 3 - 2 0 0 0

Folded edge of the page

GbsSlipSheet-001

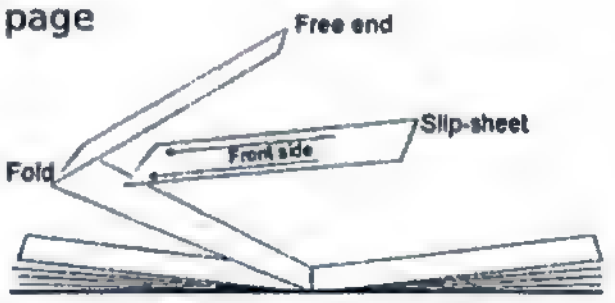
Foldout slip-sheet

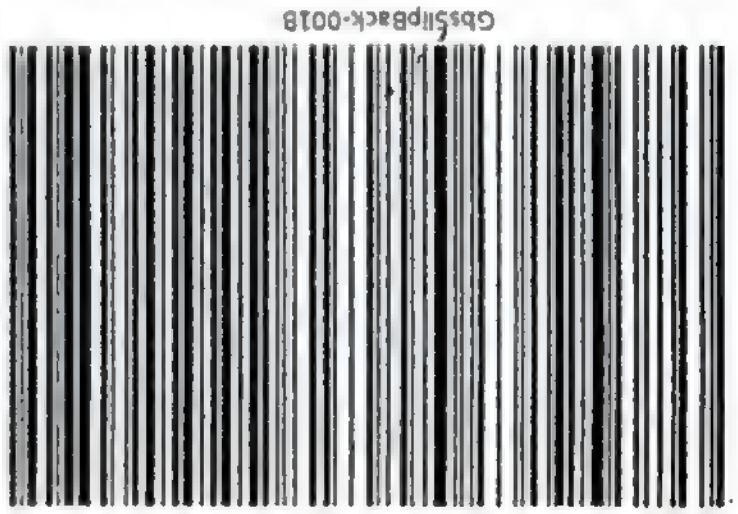
1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Holy C

Notebooks With High-Flying Perf

The paths of dashing young scientist Dakota Smith and independent journalist Lexa Kirk, drawn by seemingly mysterious forces, recently converged in South Dakota. There they made amazing discoveries: the Nomad notebooks and the astonishing little HandBook™ from Gateway 2000! Now their sworn mission is to carry the news to the far corners of the world.

"The sky's the limit!" Dakota praises the new Nomads. "These systems are every bit as powerful as their desktop counterparts! I can actually do serious computing on land, at sea or in the air!" The Nomad's patented power-management system delivers soaring battery life — over six hours from a single battery on the 25MHz 486DX system. And it has one of the biggest and brightest notebook screens in the industry.

And Lexa takes off with her HandBook, smaller than a notebook but larger and more functional than a palmtop — a real PC in miniature form! "It's a totally new category of portables, and I feel as if this little

The Explorers' Notes

HANDBOOK

- Weight 2.75 Lbs. (HandBook & Battery)
- Dimensions 5.9" x 9.75" x 1.4"
- 4.5Hr.* NiMH Battery, 1.25 Lb. AC Adaptor/Charger, 6.5" x 2.5" x 1.5"
- Traveling Weight 4.0 Lbs. (HandBook, Battery & AC Adaptor/Charger)
- C & T® Processor, 286-Class Performance
- 1MB RAM upgradeable to 3MB
- 40MB Hard Drive
- Backlit 7.6" Double-Scan CGA Screen, 640 x 400 Resolution
- 1 Parallel/1 Serial Port
- 78-Key Keyboard, 101-Key Emulation, Inverted T Cursor Pad
- MS DOS®5.0, File Transfer Software & Serial Download Cable
- Introductory Bonus Pack
- Carrying Case

$1295

Options: FieldMouse pointing device, 2,400 bps modem, alkaline battery pack, portable printer, combo unit (3.5" drive with serial port and parallel port), extra batteries

NOMAD

- Weight 5.8 Lbs. (Nomad & Battery)
- Dimensions 8.5" x 11" x 1.8"
- 6-Hr.* NiCad 5.7Ah Battery
- 14.4-Oz. AC Adaptor/Charger, 6.12" x 2.25" x 1.5"
- Traveling Weight 6.7 Lbs. (Nomad, Battery & AC Adaptor/Charger)
- Backlit 10" VGA Screen, 640 x 480 Resolution, 64 Gray Scale
- Simultaneous Video
- 1.44MB 3.5" Diskette Drive
- 1 Parallel/1 Serial Port
- External Video & Expansion Bus Ports (Ports are Full Size)
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- FieldMouse™ Pointing Device
- MS DOS 5.0 & Windows™ 3.1

NOMAD 325SXL • $1995
25MHz, 386SXL, 4MB RAM, 80MB Hard Drive

NOMAD 420SXL • $2695
20MHz, Intel® 486SXLP, 4MB RAM, 80MB Hard Drive

NOMAD 425DXL • $3495
25MHz, Intel 486DXLP, 4MB RAM, 120MB Hard Drive

NOMAD Options: 2,400/9,600 bps modems, portable printer, numeric keypad, Token Ring or Ethernet interfaces, SCSI interface, memory upgrades, executive carrying case, extra batteries

**Battery life was measured using PC Magazine's Battery Rundown Test with power management enabled. Results may vary.*

GATEWAY2000

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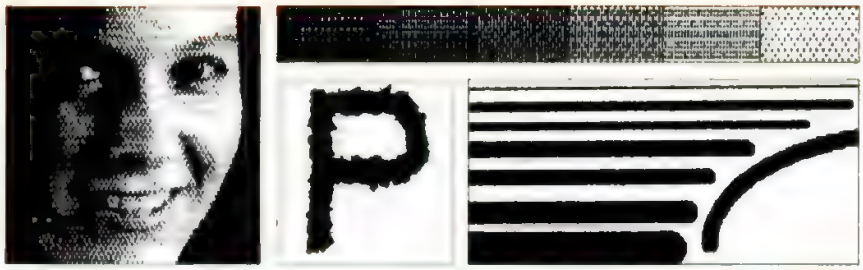
KODAK DICONIX 180si PRINTER — **$399**

12-nozzle ink jet printer

EPSON EMULATION:
- **Draft Text Speed:** 68 cps
- **Quality Text Speed:** 21 cps
- **Graphics Speed:** 0.4 gppm
- **Graphics Time:** 2 min 21 sec

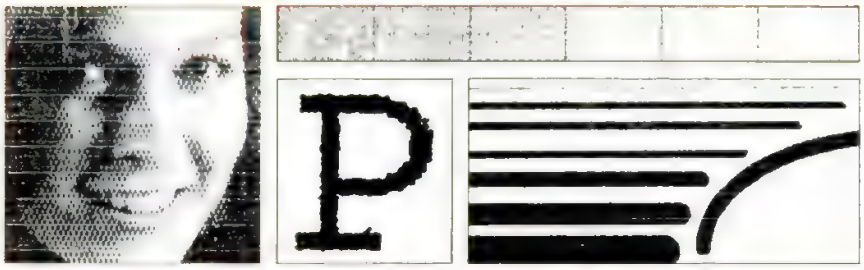
IBM EMULATION:
- **Draft Text Speed:** 68 cps
- **Quality Text Speed:** 21 cps
- **Graphics Speed:** 0.4 gppm
- **Graphics Time:** 2 min 27 sec



KODAK DICONIX 701 PRINTER — **$549**

50-nozzle ink jet printer

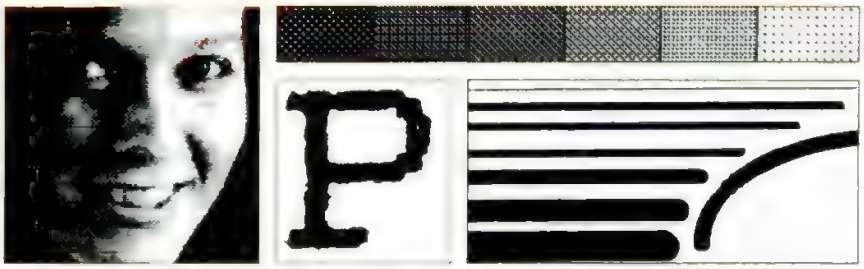
IBM EMULATION:
- **Draft Text Speed:** 60 cps
- **Quality Text Speed:** 48 cps
- **Graphics Speed:** 1.4 gppm
- **Graphics Time:** 0 min 42 sec



TOSHIBA EXPRESSWRITER 201 — **$499**

24-pin thermal fusion printer

EPSON EMULATION:
- **Quality Text Speed:** 18 cps
- **Graphics Speed:** 0.5 gppm
- **Graphics Time:** 2 min 4 sec



Eastman Kodak Co.

Kodak Diconix 180si Printer
Kodak Diconix 701 Printer

BY MITT JONES

The Eastman Kodak Co. has a knack for squeezing desktop paper-handling features into small packages. The $399 Kodak Diconix 180si Printer provides outlet-free tractor-feed capability; the larger $549 Kodak Diconix 701 Printer features a commendable 30-page sheet feeder. Neither of these capabilities is standard equipment on any other portable printer currently available.

Both thermal ink jet models feature three internal typefaces and two popular emulations. Kodak's interactive, paper-based configuration menu makes choosing among setup options easy but slow.

Kodak Diconix 180si Printer

Prestige 10 pitch
Get your facts first

Gothic 10 pitch
Get your facts first

Helvta Proportional
Get your facts first

SMALLER AND LIGHTER

The smaller, lighter, and less-capable Kodak 180si measures a trim 2.0 by 10.8 by 6.5 inches and weighs 2.9 pounds without batteries or its 0.9-pound 110-volt AC adapter. The printer comes standard with a power cord and AC adapter/charger, but no ink cartridge or batteries (the latter are available at most electronics stores, but not from Kodak). The five C-cell nickel cadmium batteries required for outlet-free operation slide directly into the printer's hollow, plastic platen. Kodak says that alkaline batteries will work in a pinch but cautions against trying to recharge them. Each 10-hour charge of the AC adapter powers the printer for 25 to 30 pages of output.

The Kodak 180si boasts an internal tractor and its single rear feed accommodates either continuous forms or cut-sheet paper, but buyers shouldn't expect full-fledged desktop functionality. The printer enforces minimum left and right margins of 0.75 inches (due to mechanical constraints), requires manual feeding of single sheets, and supports paper widths

Kodak Diconix 701 Printer

Helvetica
Get your facts first

Gothic
Get your facts first

Courier 10
Get your facts first

At Okidata® one good thing

PC MAGAZINE
EDITORS' CHOICE
JUNE 12, 1990
OKIDATA OL400

OL400

4 PPM

In June 1990, Okidata's OL400 personal page printer won a PC Magazine Editors' Choice award. The editors praised its overall performance and value – applauding its graphics and text quality, and its wide selection of built-in typefaces and fonts. All at the lowest suggested list price of any page printer available.

In November 1991, Okidata's new OL830 Adobe® PostScript® printer won the same coveted award. Once again, the editors praised our printer's overall performance and value. They found it to be the fastest of *all* 8-ppm printers tested in PCL (HP emulation) graphics mode. And considering its record-setting low price, they rated it "the best inexpensive PCL/PostScript printer available".*

leads to another.

PC MAGAZINE
EDITORS' CHOICE
NOV. 26, 1991
OKIDATA OL830

OL830

8 PPM

Both printers come equipped with an impressive list of standard features – including full HP Series II software compatibility, and the industry's only 5-year printhead warranty. Plus a choice of options to tailor either machine for your specific business or home-office application.

And both come with one additional standard feature: the Okidata OK! It's our pledge to you that every product bearing our good name will deliver not just acceptable, but outstanding performance and value.

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CIRCLE 235 ON READER SERVICE CARD

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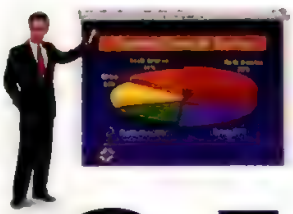
YOUR IDEAS SCREAM OUT



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FACT FILE

Kodak Diconix 180si Printer

Eastman Kodak Co., 343 State St., Rochester, NY 14650; 800-344-0006, 716-253-0740

List Price: $399 (includes AC adapter/charger and power cable); with serial interface, $419. 220V 50Hz adapter/charger, $28; 240V 50Hz adapter/charger, $28; black print cartridge, $13.95; single-color print cartridges, $19.95; carrying case, $29.95.

Requires: Parallel port.

Dimensions (HWD): 2.0 x 10.8 x 6.5 inches.

Weight: 2.9 pounds, 3.8 pounds with AC adapter.

Emulations: Epson FX-85, IBM Proprinter, and Kodak Diconix Small Printer command set.

In Short: The Kodak Diconix 180si Printer is the only truly portable candidate with tractor-feed capabilities. But other problems, such as slow speed, detract from its allure.

ON READER SERVICE CARD

from 8.5 to 9.2 inches only.

These drawbacks are understandable given the printer's small size and weight, but others are not. For instance, you must deduct 0.75 inches from the desired margin setting within DOS applications.

Another problem: In its default graphics mode, the 196-dpi Kodak 180si does not automatically compensate for having a greater resolution than the printers it emulates; this resulted in shrunken graphics on our tests. The printer also consistently offset a portion of our test image in this mode. But once configured for its expanded graphics mode, as recommended by Kodak's technical support, the printer handled graphics with aplomb, though expanded mode sometimes forced the character pitch to 10 characters per inch (cpi).

The Microsoft Windows driver that ships with the printer eliminates the need to adjust margins within Windows apps and automatically switches the graphics emulation to expanded mode. Kodak is reportedly working to provide Kodak 180si drivers for more DOS applications.

On our tests, the Kodak 180si placed last in almost all categories. In draft mode (in IBM and Epson emulations), however, its 68-cps score beat the limited competition. The Kodak 180si clocked in at 21 cps for quality text and 0.40 gppm for graphics in both emulations.

The print quality of this 12-jet offering is closer to 9-pin dot matrix output than 24-pin. Text prints sufficiently dark but with jagged edges. On the upside, the ink resisted smearing, and the printer offers Gothic, Prestige Elite, and sans serif fonts. With the $13.95 ink cartridge, output costs run near 5 cents a page for draft and 12 cents a page for letter quality.

Found for as low as $300 on the street, the Kodak Diconix 180si Printer is the only truly portable tractor-feed printer currently available. But if your printing needs are less restrictive, you may want to choose a more-capable offering.

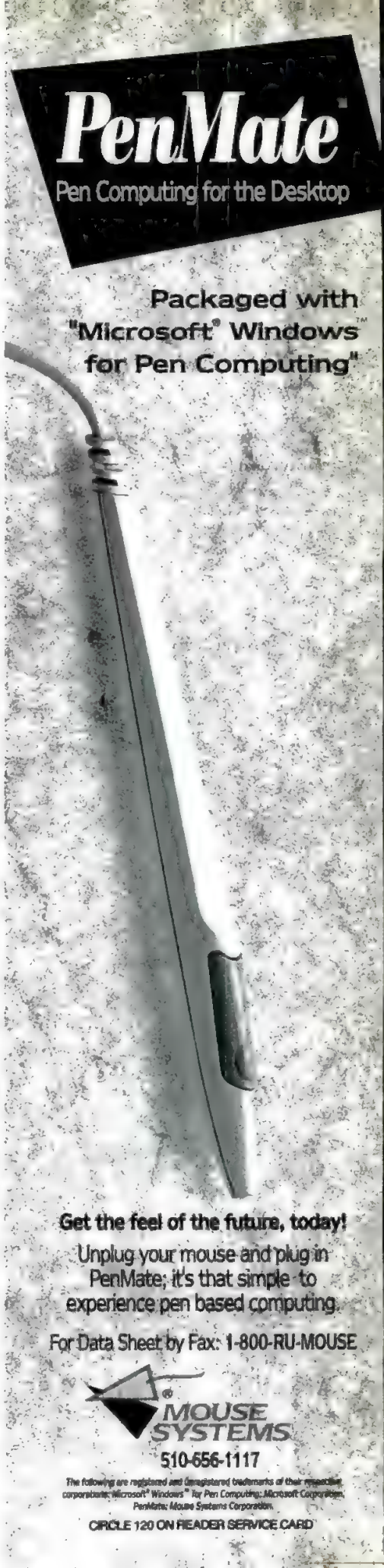
BIGGER AND FASTER

At 5.6 pounds, the $549 Kodak Diconix 701 Printer hardly lends itself to frequent travel. But the 300-dpi printer provides speed and paper-handling that no other portable can match.

The Kodak 701 measures 2.4 by 11.7 by 7.7 inches (HWD) in its traveling configuration. For cut-sheet operation, raise the top canopy (which doubles as a paper-bin) and flip up the paper-support wire. In this state, the printer requires 8.1 inches vertically and 11.1 inches from front to rear. The top-load, U paper path leaves each printed page (up to 30) stacked neatly in front of the feed stack.

The Kodak 701 ships with an AC adapter/charger, power cord, and ink cartridge in its standard configuration, but like the Kodak 180si, without a battery. The Kodak 701 requires an NP-55 camcorder battery pack, such as the $49.95 Sony NP-55. (Kodak doesn't sell a battery for this printer, either.) A 0.3-pound pack like the NP-55 powers the printer for nearly 100 continuous text pages per 4.5-hour recharge. Adding the battery and the 1.1-pound AC adapter/charger, raises the printer's weight to 7 pounds.

The Kodak 701 handled its IBM Proprinter X24E and HP DeskJet emulations without a glitch. It scored a brisk



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▶ SUMMARY OF FEATURES

Portable Printers

Products listed in alphabetical order ■ = YES ☐ = NO	Brother HJ-100i Ink Jet Printer	Canon BJ-10ex Bubble Jet Printer	PC EDITORS' CHOICE Citizen PN48 Notebook Printer	DECjet 1000	Kodak Diconix 180si Printer	PC EDITORS' CHOICE Kodak Diconix 701 Printer	Toshiba ExpressWriter 201
List price	$499	$499	$469	$329	$399	$549	$499
Battery option	$50	$50	$95	None	Third-party batteries	Third-party battery pack	$125
Cut-sheet feeder	$90	$90	None	$80	None	Built-in	None
Physical characteristics							
Technology	Ink jet	Ink jet	Thermal fusion	Ink jet	Ink jet	Ink jet	Thermal fusion
Number of pins or jets	64	64	48	50	12	50	24
Carriage size	Narrow	Narrow	Narrow	Narrow	Narrow	Narrow	Narrow
Maximum resolution (dpi)	360 x 360	360 x 360	360 x 360	300 x 300	192 x 192	300 x 300	180 x 180
Installed memory	37K	37K	4K	8K	2K	23K	500 bytes
Parallel/serial interface	■☐	■☐	■☐	■☐	■/$20	■☐	■☐
Microsoft Windows driver	☐	☐	■ (via BBS)	■ (in Windows 3.1)	■ (included)	■ (included)	☐
Paper handling							
Auto-load feature	☐	☐	■	☐	☐	■	☐
Paper feeds:							
Pressure	■	■	■	■	■	■	■
Tractor	☐	☐	☐	☐	■	☐	☐
Internal	N/A†	N/A†	N/A†	N/A†	■	N/A†	N/A†
External	N/A†	N/A†	N/A†	N/A†	☐	N/A†	N/A†
Push	N/A†	N/A†	N/A†	N/A†	☐	N/A†	N/A†
Pull	N/A†	N/A†	N/A†	N/A†	■	N/A†	N/A†
Paper paths	Rear U path	Rear U path	Bottom vertical, rear L path	Front L path	Rear L path	Top U path	Bottom vertical, rear L path
Rated maximum paper weight (pounds)	28	28	28	24	24	24	25
Rated maximum paper width (inches)	8	8	10	9	9	8.5	10
Media supported:							
Card stock	■	■	■	■	☐	☐	☐
Transparencies	☐	☐	■	■	■	■	☐
Envelopes	■	■	■	■	☐	☐	☐
Landscape printing	☐	☐	☐	■	☐	■	☐
Typefaces							
Courier	■	■	■	■	☐	■	■
Gothic	☐	☐	☐	■	■	■	☐
Prestige Elite	■	■	☐	■	■	☐	■
Sans serif	■	■	☐	☐	■	■	☐
Times Roman	■	■	■	☐	☐	☐	☐
Other	None	None	None	Times Nordic	None	None	None
Control-panel buttons							
Typeface	■	■	■	■	■	■	☐
Emulations	☐	☐	☐	☐	■	■	☐
Print mode	■	■	N/A††	■	■	■	N/A††
Customer support							
Toll-free telephone technical support	☐	■	☐	■*	■	■	■
Telephone support hours (Eastern time)	8:00–5:00 (NJ), 11:00–8:00(CA)M–F	9:00–7:00 M–F	11:00–8:00 M–F	24 hours a day *	8:00–5:00 M–F	8:00–5:00 M–F	10:00–8:00 M–F
24-hour BBS	☐	■	■	☐	☐	☐	☐
Warranty coverage (parts and labor)	12 months	12 months	12 months	12 months *	12 months	12 months	12 months

N/A†—Not applicable. The product does not have this feature. N/A††—Not applicable. This printer offers only one print mode. * Requires purchase of an extended warranty or a DEC PC.

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The Wor

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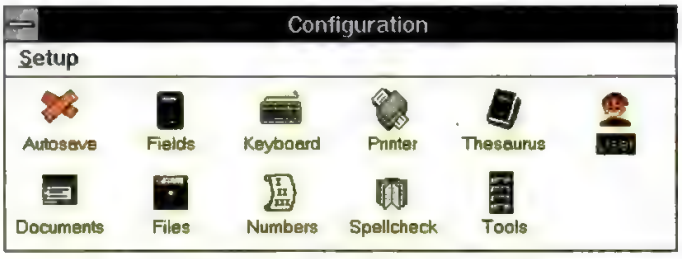
You'll be amazed at how simple it is to make your work look spectacular.

That's because CA-Textor supports over 300 different fonts, plus a full array of type styles and colors. You'll quickly discover that changing the way your words look on screen and on paper is really almost as easy as changing your mind.



CA-Textor's friendly, graphical design helps you work smarter than ever with just a few clicks of the mouse.

But that's not all.

Creating and modifying tables is a breeze with CA-Textor's powerful table editor and dynamic calculation cells.

Work on multiple documents at the same time with its advanced MDI interface.

Or insert pictures for added impact, including CGM, TIFF, WMF, WPG and BMP file formats.

And if you don't know what those mean, don't worry about it.

With new CA-Textor, you don't need to. It can even

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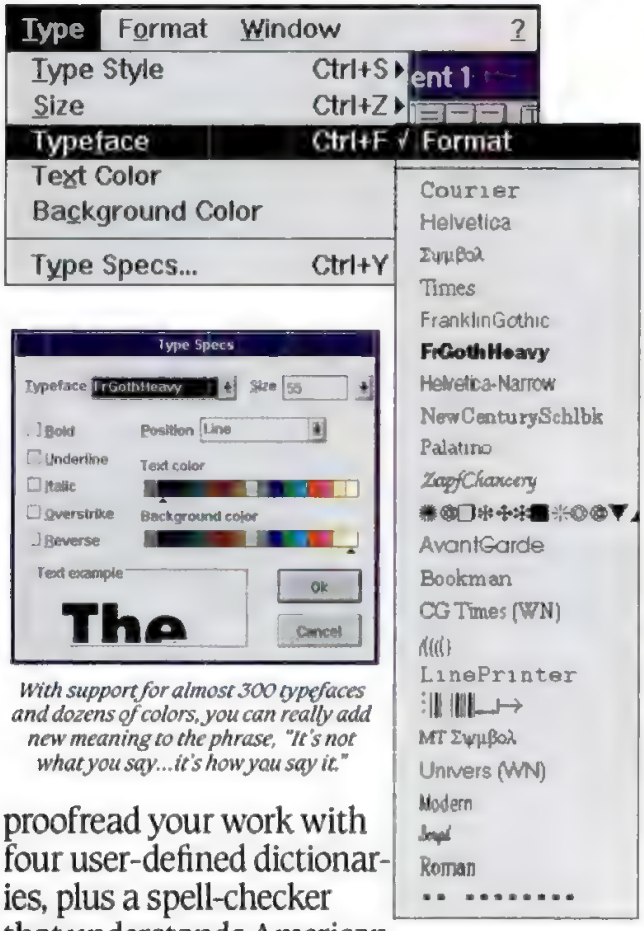
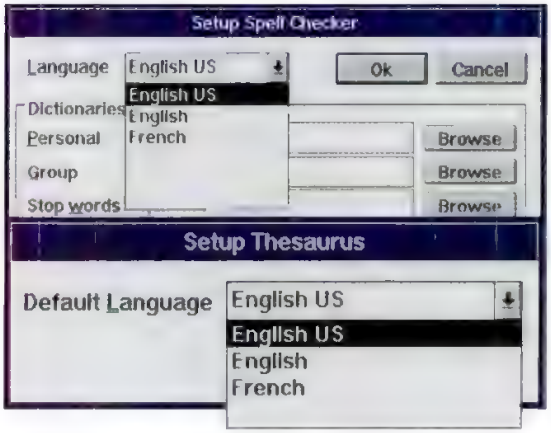
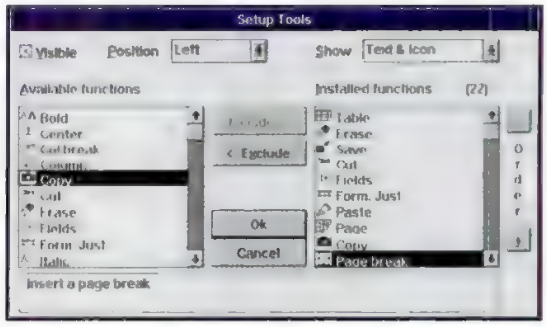


With support for almost 300 typefaces and dozens of colors, you can really add new meaning to the phrase, "It's not what you say...it's how you say it."



You'll never be at a loss for words with CA-Textor's powerful and easy-to-use thesaurus and spell checker. It's so smart, it even understands French.



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CIRCLE 378 ON READER SERVICE CARD

48 cps with 10-cpi letter quality print and 1.40 gppm on the graphics test.

The 50-nozzle ink jet Kodak 701 can't compare with the Citizen PN48 Notebook Printer when it comes to print quality, but the Kodak 701's letter-quality Courier is fine for most business correspondence. The Kodak 701 also offers Gothic and Hevta (sans serif) fonts. And the Kodak 701 provides readable 10-pitch fonts, a claim the Citizen cannot make. Graphics print smooth but light.

The Kodak 701 has a street price around $440 and ships with a Windows driver. The printer offers landscape-mode internal fonts, 24K of memory, and support for one 64-character downloadable font. With the $29.95 cartridge, per-page output costs run near 8 cents for letter quality and 6 cents for draft (which uses less ink). Unfortunately, the ink smears readily with water or highlighting.

The Kodak 701 sticks to letter, legal, and A4 media sizes. Like the Kodak 180si, it doesn't support smaller pages or envelopes. Both printers print on ink jet transparencies, but our informal trials produced only marginal results (we did not use Kodak transparencies).

The substantial Kodak Diconix 701 Printer quickly wears out its welcome as a frequent traveling companion, but its speed and cut-sheet feeder makes it attractive as a carry-along printer for dual locations or extended travel. You could also do far worse if you need a small-footprint, desktop machine.

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Kodak Diconix 701 Printer

Eastman Kodak Co., 343 State St., Rochester, NY 14650; 800-344-0006, 716-253-0740

List Price: $549 (includes AC adapter/charger, built-in 30-page cut-sheet feeder, power cable, and one ink cartridge) 220V 50Hz adapter/charger, $29.95, 240V 50Hz adapter/charger, $49.95; auto-switching fast charger/AC adapter, $149.95; black print cartridge, $29.95

Requires: Parallel port.

Dimensions (HWD): 2.4 x 11.7 x 7.7 inches, 8.1 x 11.7 x 11.1 inches with sheet feeder

Weight: 5.6 pounds, 7.0 pounds with battery and AC adapter/charger.

Emulations: IBM Proprinter X24E, HP DeskJet, and Kodak Diconix Small Printer command set

In Short: The Kodak Diconix 701 Printer may prove a bit cumbersome for frequent travel, but its built-in, 30-page cut-sheet feeder makes it the best choice for long-term stays and transportable desktop applications

550 ON READER SERVICE CARD

Toshiba America Information Systems Inc.

Toshiba ExpressWriter 201

BY JENNIFER ZAINO

Small size and light weight characterize the Toshiba ExpressWriter 201, but so do a minimalist 180-dpi resolution, a choice of only two fonts, and a single emulation. The $499 list price includes an AC adapter, proprietary Centronics and power cables, and one ribbon cartridge; tack on $125 for the optional battery. A pack of five additional multistrike cartridges costs $29.

The ExpressWriter's list price seems a little high when compared with the $469 cost of the Citizen PN48 Notebook Printer ($549 with battery), which uses a similar thermal-fusion mechanism. The price difference is even more glaring when you consider that the Citizen PN48 offers 360-dpi resolution and Epson LQ, IBM Proprinter X24, and native emulations, while the ExpressWriter provides only 180-dpi resolution and Epson LQ emulation. In addition, the ExpressWriter cannot load paper automatically: You have to push the paper through manually and align it with the plastic edge of the top cover.

Toshiba markets the ExpressWriter as a laptop accessory. And at a compact 1.8 by 12 by 3.1 inches (HWD) and 4.1 pounds (including AC adapter and battery), the printer fits best as an on-the-road tool for creating draft-level output. The unit's low resolution and media limitations preclude using it for outputting fi-

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Digicom Systems, Inc

188 Topaz Street
Milpitas CA 95035

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HP LaserJet III®

MT908 *Laser Printer*

Okay, here's a hint. The market leading laser printer features HP® PCL5 printer control language. The MT908 laser printer from Mannesmann Tally is PCL5 compatible, as well. Oops. The market leader provides 8 scalable fonts. The MT908 gives you the same scalable fonts. Hmm. The market leader offers a feature for smoother edges on fonts and graphics. The MT908 has Edge Enhanced Technology (EET®) for the same effect.

Alright. What about performance? The market leader prints at 8 pages per minute and includes the processing power of the Motorola 68000. The MT908 prints at 8 pages per minute but provides 2.5 times faster processing of scaled fonts and graphics with its Intel i80960 RISC processor. Now we're getting somewhere.

The market leader comes with a 250 sheet capacity letter-size cassette. If you want to load legal paper, envelopes etc., you'll have to buy additional cassettes. For more convenient paper handling, the universal paper cassette of the MT908 adjusts to hold 250 sheets of letter, legal and international sizes or up to 30 envelopes. And, there is an optional 300 sheet second paper bin that mounts under the MT908 ... you can't even buy that from the market leader.

Bottom line: the Mannesmann Tally MT908 gives you all the features of the market leader with faster processing for faster throughput, better paper handling and has a list price of only $1,995... $400 less than the market leader*.

You can even add built-in PostScript® language compatibility.

So any way you figure, the answer comes up the same. The MT908 looks better, and so does the price.

For the name of your nearest dealer, call:

1-800-843-1347 Ext: 493

Mannesmann Tally Corporation
Kent, Washington

A mannesmann *technology company*

*Based on HP LaserJet III suggested list price of $2,395

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CIRCLE 056 ON READER SERVICE CARD

nal contracts, formal business correspondence, or presentations. You can do envelopes in a pinch, but not easily. Note, however, that while Toshiba doesn't recommend printing on transparencies, we were able to use them without trouble.

The unit comes equipped with 10-pitch Courier and 12-pitch Prestige Elite fonts only. It defaults to Courier, and it lacks control panel commands or dip switches to access the other font.

Although the printer easily handles continuous-feed paper, it is recommended for use with cut-sheet paper only. You can load paper from the top or turn the printer on its back and feed paper straight through from the bottom. The ExpressWriter accommodates 10-inch wide paper (which must be loaded from the top) by opening a side cover to give the cartridge holder room to move beyond the platen.

Turning the multistrike ribbon over will get a second use out of it, but in testing this led to ghosting problems. When using the ribbon once, output costs run near 41 cents per page; cost per page will drop if you reuse the ribbon.

Toshiba ExpressWriter 201

```
Courier
Get your facts first.

Prestige Elite
Get your facts first
```

The nickel cadmium battery, rated for about 60 pages, attaches in a somewhat cumbersome manner. The battery screws onto the bottom of the printer and adds almost an inch to the unit's height.

PERFORMANCE

The text and gray-scales look good, especially given the printer's low-level resolution. But the unit had trouble with the jaggies, particularly on curves, and the graphics mode test image was dark.

The product does not ship with its own Microsoft Windows driver; Toshiba advises you to use one of the Epson LQ drivers included with Windows 3.1. You might be tempted to choose the LQ-2550 driver, but informal testing showed that the LQ-1550 driver produced a better-detailed if lighter graphics image.

Speed is not this printer's forte. On our quality text test under Epson emulation, the unit trailed the pack with a rating of 18 cps. The printer fared little better on our graphics test: At 0.50 gppm, it tied the Kodak 180si for fourth place.

The Toshiba ExpressWriter 201's problem is that it is priced beyond its capacities, even with the 10 percent street discount. The printer's resolution, speed, and capabilities are fine for on-the-road draft-level printing, but the price isn't. □

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FACT FILE

Toshiba ExpressWriter 201

Toshiba America Information Systems Inc., Computer Systems Division; 9740 Irvine Blvd.; Irvine, CA 92718; 800-457-7777, 714-583-3000; fax, 714-583-3827

List Price: $499 (includes AC adapter/charger, power and connecting cables, and one multistrike cartridge) Nickel cadmium battery, $125, five ink cartridges, $29

Requires: Parallel port.

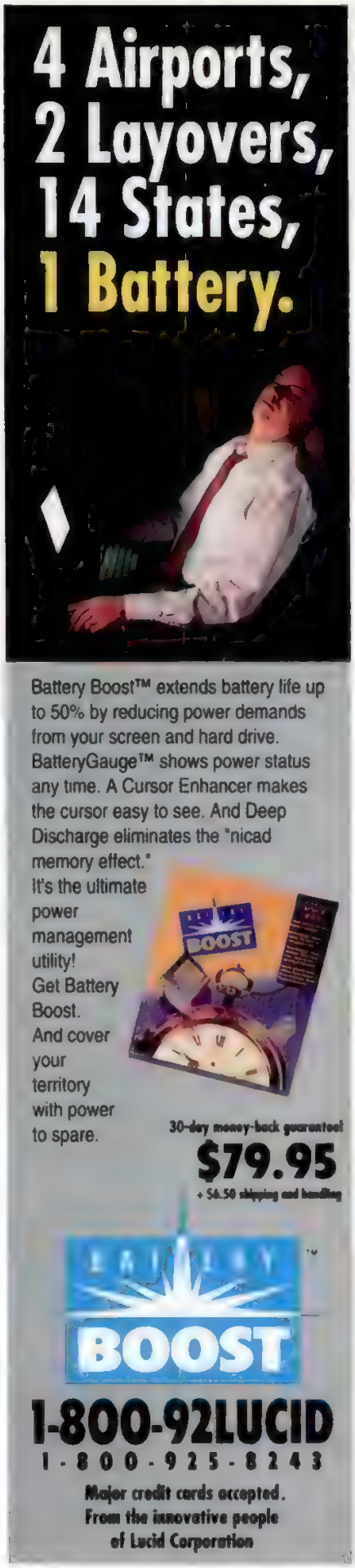
Dimensions (HWD): 1.8 x 12 x 3.1 inches, 2.6 x 12 x 3.1 inches with battery pack

Weight: 1.9 pounds, 3.2 pounds with battery, 4.1 pounds with battery and AC adapter.

Emulations: Epson LQ.

In Short: The Toshiba ExpressWriter 201 makes a lightweight and compact traveling companion. But with only 180-dpi resolution, two internal fonts, and a single emulation to offer, the system is priced beyond its capabilities.

557 ON READER SERVICE CARD



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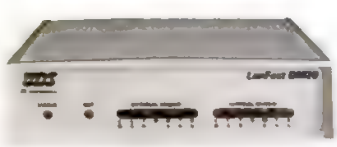

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PORTABLE AND FAST

Sizzling Modems To Go

Power laptops now have the perfect complement: high-speed portable modems. These seven V.32 and V.32bis demons give you the speed you want, at a higher price than their desktop counterparts.

PHOTOGRAPH BY RICK BECKER

Maybe adding a blazing-fast modem to your laptop won't make you more productive, but don't be too sure. The jump from 2,400 to 9,600 bits per second and beyond does wonders. At a blink of an eye, you can instantly receive volumes of e-mail or ship gigantic files back to the office.

To see just how robust such new modems are, ZD Labs tested both internal and external portable models under rigorous conditions, simulating coast-to-coast and satellite-aided connections. We found that some modems offer performance, portability, reliability, or low cost, but none offer all four effectively.

IN THIS REVIEW

Compaq Enhanced 9600-bps Internal Modem	*376*
Dallas Fax 9696P	*389*
The Dispatcher V.32bis Cellular Ready Data/Fax Modem	*396*
The Megahertz C596FM Laptop FAX/Modem	*393*
The Megahertz T396FM Laptop FAX/Modem	*393*
The Megahertz P296FMV Pocket Laptop FAX/Modem	*396*
QBlazer	*401*

by Frank J. Derfler, Jr.

We reviewed seven modems from five vendors: three external and four internal. The external modems (the Dallas Fax 9696P, The Megahertz P296FMV Pocket Laptop FAX/Modem, and Telebit's QBlazer) differ in weight, price, and power source.

The internal modems also differ in their performance and in the machines they support. We reviewed three modems designed to fit inside Compaq laptops: the Compaq Enhanced 9600-bps Internal Modem, The Megahertz C596FM Laptop FAX/Modem, and Piiceon's Dispatcher V.32bis Cellular Ready Data/Fax Modem. We also examined The Megahertz T396FM Laptop FAX/Modem, which slides into certain Toshiba computers.

With a reasonable price tag of $599, high performance, and lots of LEDs, the QBlazer was the runaway favorite for Editors' Choice. Its only two drawbacks are its unusual shape and its lack of fax capability.

Though we did not select an Editors' Choice among the internal modems, the Compaq unit did earn an honorable mention for its strong performance and reasonable price tag ($599).

REVIEW CRITERIA

The modems reviewed had to be truly portable and to support at least the V.32 standard (with a signaling speed of 9,600 bits per second). Some modems also offered faster V.32bis signaling (14,400 bps) with MNP 5 or V.42bis compression (for a review of desktop V.32bis modems, see "Maximum Modems: 14,400 bps and Rising," *PC Magazine*, March 17, 1992).

Missing from the mix are Microcom's MicroPorte 4232bis and U.S. Robotics' WorldPort 9600. The WorldPort 9600 was being reengineered at the time of our testing. U.S. Robotics plans to implement MNP 2 through 5 in the new version; the current product does not support MNP 3. The new modem will also be based on U.S. Robotics' Courier technology, the company's high-speed modem line. Owners of the WorldPort 9600 can upgrade to the new modem for $49. Check with U.S. Robotics (800-982-5151) for more details.

Microcom provided us with the MicroPorte 4232bis but had to recall the modem because of a manufacturing defect. A replacement was not available in time for our testing. An external V.32bis pocket modem from Practical Peripherals, the PM14400 PKT, did not arrive in time for testing and is not expected to ship until September.

Micro Integrated Communications Corp. also introduced an external portable modem, the MICC Pocket Fax Modem, which supports 14.4-bps fax and data; that modem will be shipping by the time you read this. A beta version of Multi-Tech Systems' MultiModem µ did arrive in time and is reviewed in a sidebar ("MultiModem µ: High Speed, Fax, and More").

If the price is important and you can sacrifice performance, plenty of 2,400-bps portable modems are on the market. Many of these products also come with 9,600-bps fax capability (see the table "2,400-bps Portable Modems: What's Out There").

HIGHLIGHTS

Portable High-Speed Modems

SEVEN PORTABLE modems are reviewed here, all offering signaling speeds of at least 9,600 bps.

MODEM VENDORS are constantly updating their firmware, and it's always a good idea to check with a vendor to find out whether you can get an upgrade. A case in point: Both Dallas Fax and Megahertz Corp. say they have improved their products' performance by offering new EPROMs.

THE COMPAQ ENHANCED 9600-bps Internal Modem was the best-performing internal modem we reviewed, while Telebit Corp.'s QBlazer was the best-performing external modem. Neither modem includes fax support, however.

THE DISPATCHER V.32bis Cellular Ready Data/Fax Modem, from Piiceon, includes both fax and cellular communications capabilities. Multi-Tech Systems' MultiModem µ (the Greek letter mu) also includes these features, and it lets you send and receive faxes in the background.

THE MOST PORTABLE of the external modems is the Dallas Fax 9696P, with a weight of 5.5 ounces and dimensions of 0.9 by 2.4 by 4.3 inches. Compaq, Megahertz, and Piiceon make internal modems that fit inside specific portable machines.

THE MEGAHERTZ CORP. internal and external modems offer a convenient power-saving feature to stretch the life of the two AA batteries they require. They automatically power down when you're not using them.

ONE OF THE BEST reasons to choose an external modem is for the status lights, which help in troubleshooting. The QBlazer offers 8 different status lights, while the MultiModem µ gives you 12. The extra status lights can indicate line speeds, fax connection, battery status, and data compression.

THE PCMCIA specification, which will be used in actual products sometime this year, will provide a standard credit card–size slot in portable computers for devices such as internal modems and network adapters.

WHAT'S IN A MODEM?

Despite changes in speed and capabilities, modems have remained remarkably similar. All modems convert between the direct-current signals in your computer and the alternating-current signals that travel over telephone lines. The modems reviewed here have evolved over several generations to control the way they signal each other, compress data, control errors, and talk to computers.

Architecturally a modem consists of a variety of components, the major ones being the data pump, the compression engine, and the serial port controller. The data pump determines the modem's line speed and also converts data bits to tones and vice versa. The compression engine takes incoming and outgoing files and reduces or restores them. Both the data pump and the compression algorithm run on a single chip set manufactured by

AT&T. The serial port controller is positioned between the compression engine and the serial port so that it can respond to the computer's RS-232 signals about flow control and modem control.

EDITORS' CHOICE

• **QBlazer**

Telebit Corp.'s $599 external modem, the QBlazer, wins our Editors' Choice designation for excellent performance and a generous set of eight status lights that helps you troubleshoot connections. Although it is larger than the other external modems that are reviewed here, the QBlazer is still portable enough to take anywhere. The main drawback, no fax capability, pales beside its data communications performance.

The Compaq Enhanced 9600-bps Internal Modem is an honorable mention. It offers the best mix of price ($599) and performance, although it runs only with Compaq laptops and lacks fax capability.

You can gain fax and data capability with the Dallas Fax, Megahertz, and Piiceon modems. The Dallas Fax and Megahertz models we tested, however, were far slower than the Compaq or the QBlazer. Piiceon's Dispatcher V.32bis Cellular Ready Data/Fax Modem does offer cellular capability and V.32bis—but at a list price of $979.

TEST RESULTS

We stressed each of these different components by using two sets of tests. The first looked at the modems' raw throughput under varying line conditions. The second looked at their compression capabilities.

In a well-designed modem, the serial connection to the computer is the limiting factor when you are sending a highly compressible file. When you send a moderately compressible file, the data pump also becomes a factor.

On most of our tests, the Dallas Fax and three Megahertz units had comparatively slow throughput scores. We suspect the problem lies in their use of older firmware executing the V.32, V.42bis, or MNP 5 protocols. Indeed, both companies have subsequently released new EPROMs from AT&T that should alleviate the problem.

The Compaq, Dallas Fax, and Telebit modems were able to take the best advantage of compression on our highly compressible file, a text file with a repeated phrase. But for generic text file transfers, the Piiceon, Compaq, and Telebit units were the best.

On the Incompressible File tests, Piiceon's Dispatcher V.32bis Cellular Ready Data/Fax Modem was clearly the fastest. That should come as no surpise since it's the only one to support both V.32bis and V.42bis protocols; all the other modems we reviewed meet only the V.32 and V.42bis specs, and consequently we tested them at a line speed of 9,600 bps. But that doesn't make this unit the best. Since Piiceon uses TIES (a time-independent escape sequence), some files may not be transferable.

For greater reliability, you can turn to the modems based around the Heatherington escape sequence, the Compaq Enhanced 9600-bps Internal Modem and Telecom's QBlazer. We'll explain why shortly. Both performed well for V.32 modems, with decent error control and data compression.

In a well-designed modem, the PC's serial connection is the limiting factor when you are sending a highly compressible file.

The Compaq and Piiceon modems could not complete the satellite-aided link test, because the signal we used was weak enough that the modems decided not to attempt the connection. It is up to the vendor to decide how to handle a bad signal; there are good reasons for not attempting the connection and risking a loss of data.

ZD Labs also tested the modems with various commercial communications programs. All of the modems worked without problems with every program we tried: Crosstalk XVI, Lotus Express, Procomm Plus, Relay Gold for DOS, and Smartcom III. Telebit's QBlazer worked only with a current version of Smartcom III, however, not with earlier versions.

Dallas Fax, Megahertz, and Piiceon ship their modems with MTEZ and ExpressFax. Telebit ships its modem with MTEZ. All of these companies' units worked well with MTEZ on our tests.

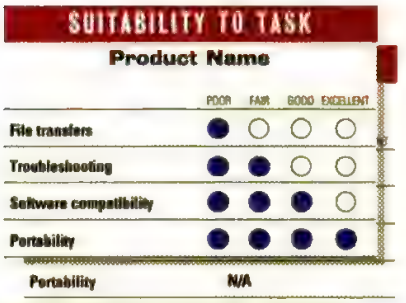
TAKING ADVANTAGE OF CHIP SETS

All of the products had some characteristics in common, such as the command sets supported. All of the modems work with Hayes or Microcom commands. The Dallas Fax, Megahertz, and Piiceon modems offer the Microcom command set, typically identified by the percent sign (%) in the command string, for higher-level commands involving data compression, error control, and RS-232 port speed. The Compaq modem is unique in that it can also use the Hayes commands, identifed by an ampersand (&) in each command string. The Telebit modem uses an extension of the Hayes Smartmodem 2400 command set but uses neither Hayes nor Microcom commands for data compression or error control.

All of the modems use asynchronous transmission. The Compaq, Dallas Fax, and Piiceon modems also offer synchronous transmission, a technique developed for mainframes. In synchronous communications, devices send an uninterrupted flow of bits and then use a common clock to break a data string down into characters. Although synchronous communications are very efficient, they are also costly for modems that need expensive circuitry to synchronize their oscillators. In contrast, asynchronous-communication modems do not need this circuitry. Special bits embedded in the data stream indicate where each character ends.

Suitability to Task: Portable Modems

The communications priorities of portable modem users differ depending on whether they need the fastest file transfers, good diagnostics, or the lightest equipment. Use our Suitability-to-Task ratings to help you decide which is the best modem for you.



N/A—Not applicable. The product does not perform this task.

The transmission and diagnostic functions of each modem are rated according to their usefulness in four areas.

File transfers evaluates the modem's ability to upload and download binary and ASCII files over normal and impaired lines. Flow control, automatic error control, and data compression negotiation, as well as the robustness of built-in protocols, are important considerations. The product should make it easy to transfer files at the highest possible speeds and the highest levels of error control and data compression.

Troubleshooting rates the modem's ability to indicate its settings and the ease of adjusting them. The number and visibility of the status lights are important. The modem should display its register settings when you issue the appropriate commands, should return informative connect messages, and should include an audible, adjustable speaker.

Software compatibility rates the product's ability to work with a wide variety of comm software, based on the command set for the modem and tests we conducted with a selection of packages, including Crosstalk XVI, Lotus Express, Procomm Plus, Relay Gold, Smartcom III, and other popular programs.

Portability evaluates the external products' suitability for use on the road. The battery should be replaceable, rechargeable, or both. A recharger, if needed, should be supplied with the modem; the weight and size should be small, and replacement batteries should be available at retail outlets.

All of the modems support a wide range of singaling standards and modulation protocols. The signaling speed of modems across dial-up telephone lines ranges from 110 to 14,400 bps. Modulation protocols specify the aspect of the signal that changes and how it changes. The Compaq, Dallas Fax, and the Megahertz modems support Bell 103, Bell 212, V.21, V.22, V.22bis, V.23, and V.32 modulation protocols. Telebit's QBlazer offers all of these except V.21 and V.23. (See the sidebar "Modem Standards: AT&T, MNP, and CCITT.")

The two data-compression protocols built into the modems tested here are MNP 5 and V.42bis. V.42bis, a comparatively new protocol, is far more efficient than its predecessor; it uses an algorithm that does a superior job of reducing redundancy. But V.42bis is protected by patents requiring expensive licenses. Therefore, modems offering its higher throughput cost more than those that come with only MNP 5.

Finally, all of the modems use the popular MNP 4 and V.42 error-control protocols. With both of these protocols, modems can request a retransmission of received data if an error is detected.

PURCHASING CRITERIA

What defines a good portable modem? That depends on whether you prefer an external or internal modem and what you plan to accomplish with the product. With internal modems, the most important concern is that the product actually fits and works in your laptop. But many factors deserve consideration.

• **Performance.** All modems should be able to provide a fast, reliable connection. If you really want speed, look for a V.32bis chip set. The fastest modem, Piiceon's Dispatcher V.32bis Cellular Ready Data/Fax Modem, employs V.32bis signaling (14,400 bps). More modems will certainly gain V.32bis capability during the next few months, but currently all other vendors are using V.32 signaling (9,600 bps).

• **Reliability.** The raw speed of file transfer is not nearly as important as the accuracy of the transfer. If the file isn't accurately transferred, it's of little use. Error control is an important part of the transmission process. If you intend to move a lot of source code or character-based graphics files, the type of escape sequence used may also affect reliability.

Today there are two types of escape sequences: the Heatherington escape sequence and the time-independent escape sequence (TIES).

Heatherington, the more reliable of the two, is used by the Compaq and Telebit modems. This escape sequence employs the string "+++", preceded and followed by 1-second silences, to alert the modem that the following sequence of data is a command instead of something to send over the phone line.

All other modems in this review use TIES ("+++AT" with no time restriction). Under some circumstances (particularly with a C source-code file or a character-based graphics file, or as part of the internal format of communications that is generated by a specialized application), a string of data can imitate this kind of escape sequence, which will throw the modem into command mode and interrupt operation for no easily discerned reason.

• **Modem Status Reporting.** This is a third key element in choosing a portable external modem. Such modems differ in the amount of feedback they provide during a call. Status lights and an internal speaker indicate the progress of the communications link. The QBlazer has 8 status lights, but the MultiModem μ has a sparkling array of 12 LEDs. The Dallas Fax 9696P lacks lights and even the speaker found in the other products. Internal modems usually use the PC's speaker but don't provide the diagnostic lights.

• **Power Supply.** As a small plus, external modems don't take power from the laptop's battery as the internal products do. They use external batteries, typically one 9-volt or two AA batteries. While this feature could allow you to gain a few minutes of computer operating time, it also means that you'd better have spare modem batteries readily available or carry the modem transformer. The battery life you enjoy will depend greatly on the batteries and how often you use the modem; expect several hours of on-line time as a minimum.

• **Dimensions.** As a rule, smaller is better.

FOR TOKEN RING

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COMPUTERWORLD

LAN TIMES READERS CHOICE 1992

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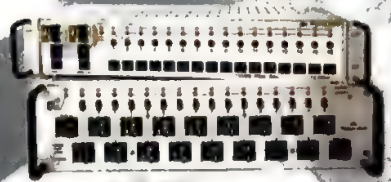

Enhanced Multistation Access Units

CONNECTS

Simplify network connectivity and reduce costs with Thomas-Conrad MAUs. They give you 16 ports – twice the usual number – plus diagnostic LEDs, enable/disable switches for each port, and a built-in AC power supply. And, they let you connect workstations on 4- or 16Mbps networks, using either unshielded or shielded twisted-pair cabling.

CONTROLS

Token Ring Network Management Software

Keep your token ring environment looking picture-perfect with our new, easy-to-use client/server-based diagnostic software called Sectra™. Sectra consists of two modules; a NetWare® Loadable Module for NetWare servers, and a client module for workstations. Sectra lets you set alert threshold levels and control node access. It collects data in real time, and shows you exactly what's going on, so you can head off problems before they become critical. And, Sectra Client works with Microsoft® Windows™, giving you point-and-click access to network control functions.

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Only Thomas-Conrad gives you toll-free technical support, 7 days-a-week, 24 hours-a-day, absolutely FREE. And, we carefully test and burn in each product we manufacture in our Austin, Texas facility – that's your assurance of the highest quality and reliability.

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CIRCLE 330 ON READER SERVICE CARD

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Carrying a laptop shouldn't break your back, and neither should carrying a modem. Modems come in varying sizes, and many unfortunately include a connector that sticks out the back. We recommend that the modem be no larger than 2.5 by 4.5 by 2.5 inches.

PCMCIA AND BEYOND

What's next for portable modems? In looking at these modems, three future trends become clear. Probably the first is miniaturization. With the advent of the Personal Computer Memory Card International Association (PCMCIA) specification, vendors are shrinking 2,400-bps modems and other peripherals down to around credit-card size, but for various technical reasons you shouldn't expect to see high-speed PCMCIA-standard modems in the near future. See the sidebar "PCMCIA: A Great Standard, But Where Are the Products?"

Fax support is spreading. Although our Editors' Choice, the QBlazer, lacks fax support, the Dallas Fax, Megahertz, and Piiceon modems can exchange faxes with any standard Group III fax machine—practically every machine in common use—and they follow the EIA Class 1 fax modem specification.

Probably the most intriguing area for high-speed modems is cellular communications. With cellular capability, you can communicate through specific car phone models. The Piiceon modem already has the ability to interface with an optional Piiceon cellular telephone connector. Any modem will work over a cellular link, but you need a special electrical interface such as Telular's CelJack (708-256-8000) or one of the rare phones with an RJ-11 connector. Companies such as Microcom (800-822-8224), Spectrum Cellular Corp. (800-233-2119), and Telebit Corp. (800-835-3248) market modems with special error-control protocols for noisy cellular circuits. (For more information, see "Data on the Go: Three Cellular Modems," December 25, 1990.)

PACK UP AND MOVE OUT

These high-speed portable modems give travelers the same high-speed connections people have come to expect from their office computer systems. They are practical and reliable devices that can quickly move your data along the road.

Compaq Computer Corp.

Compaq Enhanced 9600-bps Internal Modem

ALL REVIEWS BY M. DAVID STONE

The Compaq Enhanced 9600-bps Internal Modem is the sort of no-nonsense package that concentrates on doing one

▪ Modem Standards: *AT&T, MNP, and CCITT*

With all the standards available to modem buyers these days, it is easy to be confused by the various levels of signaling speed, error control, and data compression you can pay for. V.42, for instance, is an error-control protocol, while the similar-sounding V.42bis refers to data compression. The accompanying chart shows the modulation methods and in-modem protocols you will commonly find in the units available today. Among the lowest-priced 2,400-bit-per-second products are those offering V.22bis speed and modulation with V.42bis data compression and V.42 error control.

Among Microcom's MNP (Microcom Networking Protocol) standards for modem control is MNP 5, which allows for an average throughput increase of 40 percent using on-the-fly data compression. The MNP 4 standard ensures a high-quality connection through Adaptive Packet Assembly, a method that sends packets sized to match the quality of the connection: The better the connection, the larger the packet sent. Microcom's standards 5 and up are proprietary and thus must be licensed by other modem vendors.

By contrast, the CCITT (Comite Consultatif International Telegraphique et Telephonique) has developed modem signaling and control standards on an international scale. And many modem manufacturers still support the older Bell standards developed by AT&T.

Data compression

MNP 5
Microcom's licensed protocol, capable of a 2-to-1 compression ratio.

MNP 7
Microcom's licensed protocol, capable of a 3-to-1 compression ratio.

V.42bis
A CCITT standard that allows a 4-to-1 compression ratio.

Error control

MNP 2, 3, and 4
Three levels of a control scheme from Microcom.

LAPM
Link Access Procedure for Modems, the primary basis for the CCITT V.42 protocol.

V.42
A CCITT protocol that incorporates a fallback to MNP 2, 3, and 4 if LAPM, the primary protocol, is not available.

Signaling speed

Bell 103
An AT&T standard for full-duplex signaling at up to 300 bps.

Bell 212
An AT&T standard for full-duplex signaling at 1,200 bps.

V.21
A CCITT standard for full- and half-duplex signaling at up to 300 bps.

V.22
A CCITT protocol that enables signaling at 1,200 bps.

V.22bis
A CCITT scheme that governs full-duplex signaling rates of 1,200 and 2,400 bps.

V.23
A CCITT standard that governs half-duplex signaling at 600 and 1,200 bps with a reverse channel of 75 bps.

V.32
A CCITT standard that governs full-duplex signaling at 4,800 and 9,600 bps.

V.32bis
A CCITT protocol that allows signaling at 4,800, 7,200, 9,600, 12,000, and 14,400 bps.

"No matter how much we grow, we know we can bank on the LANtastic networking system."

MIS Manager Nola Matthews and Tracy Schmidt, VP of Operations, First Interstate Bank of South Dakota, N.A.

THE BIG SWITCH
INTERVIEW #5:

LANTIMES READERS CHOICE 1992

PC MAGAZINE EDITORS' CHOICE
April '92, 1992
LANtastic, Version 4.10

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In the summer of 1991, the Credit Card Division of First Interstate Bank of South Dakota needed to network 10 computers. Since they already had an open Novell® license, their first inclination was to go with Novell. But Sandy Silverberg, of **Ideasign Computers**, an Artisoft Authorized Five Star™ dealer, urged them to check out the LANtastic® networking system. Since a neighboring department was running a Novell NetWare® network (v2.15) and another department was running a LANtastic network, comparisons were easy. They chose the LANtastic system and are now up to **100 nodes** – and growing. Why did they choose LANtastic?

"Our primary considerations were the LANtastic system's peer-to-peer capabilities, its ability to interface with our mainframe, the ease of its installation and maintenance and the significant cost-savings over Novell," says Tracy Schmidt, VP of Operations. **"The installation turned out amazingly fast and simple. I left work at 7:00 one evening with no network and when I came in the next morning, our people were already signed on and productive."** Nola Matthews, MIS Manager, says, "The system has been extremely reliable and we have received excellent, unlimited and free technical support from Artisoft. We are using two 3270 gateways, which provide us with up to 80 simultaneous sessions on a mainframe. From its low cost to its reliability to its ease of use, our LANtastic network has proved to be a complete and remarkable package."

Thanks, Tracy, Nola and Sandy. We appreciate your giving us all that credit.

If we've raised your interest about networking your PCs – or about switching from NetWare to the award-winning LANtastic networking system, call **1-800-TINY RAM, ext. 600**. You'll get all the facts, including our special conversion price of **$499** for up to 300 nodes. **This saves you $2,000.*** We'll also give you the name of the Artisoft Authorized Five Star dealer nearest you.

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*Oil manufacturer's suggested retail price.

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CIRCLE 254 ON READER SERVICE CARD

SmartSuite The best soluti in Win

SmartSuite from Lotus... the complete business solution for Windows™ desktops.

If you're looking for a better way to work in Windows, SmartSuite™ from Lotus® is one smart choice. Because not only does this suite of four award-winning Windows products offer you an incredible value for your money. It also delivers individually outstanding products that work together. Each shares a common interface. As well as common features like our unique SmartIcons™ for one-click access to the tasks you perform most frequently. Which means the products work so much alike that when you learn one you've learned them all.

"Lotus 1-2-3 for Windows is completely Windows and completely 1-2-3."
–Windows Magazine, 11/91

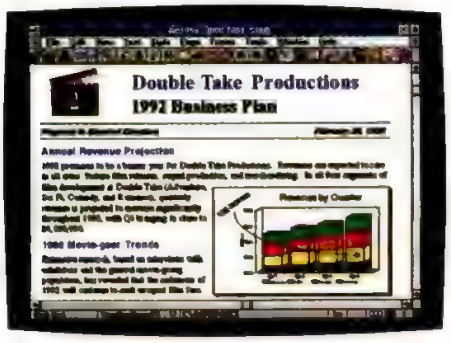
It's pure Windows. Pure 1-2-3.

Take 1-2-3® for Windows, for example. It brings you all the power of The World's Most Popular Spreadsheet,™ including 3-D worksheets, automatic print compression and our unique Solver technology. And it now includes file compatibility with Microsoft® Excel, support for Windows 3.1 and overall improvements in its performance and speed. It even gives DOS users access to the 1-2-3 for DOS Classic® menu at the mere push of the slash key.

PC MAGAZINE EDITORS' CHOICE
February 25, 1992
Ami Pro Version 2.0

Ami Pro. Words alone can't describe it.

With Ami Pro,™ you'll find a feature-rich, easy-to-use word processor that comes with dozens of pre-formatted Style Sheets. Which means you can get professionally designed letters, memos and reports as fast as it takes to type in your text. In fact, only Ami Pro gives you visual cues every step of the way. Without any complicated screen commands to remember.



"Ami Pro stands unchallenged as the most powerful and enjoyable Windows word processor."
–PC Magazine, 11/21/91

PC MAGAZINE EDITORS' CHOICE
March 17, 1992

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More good news? SmartSuite costs less than the price you'd expect to pay for two of these products. And it even includes a free Windows 3.1 tutorial from Personal Training Systems,® complete with an audio cassette, manual and demo disk.

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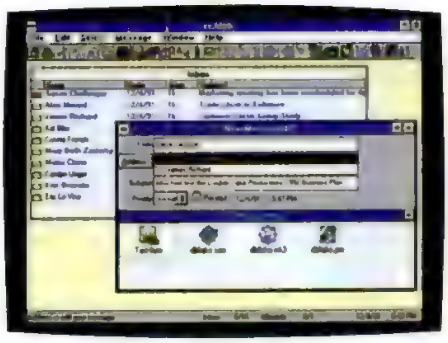
"No other presentation package lets you go from initial idea to final product with greater ease."
–PC Computing, 11/91



"Sending a cc:Mail message is easier than addressing an envelope and licking a stamp."
–PC World, 9/91

cc:Mail. The leader in electronic mail.

And cc:Mail™? It's the most popular electronic mail package in the world. Take a quick look at what it delivers and you'll know why.

Lotus **SmartSuite for Windows**
1-2-3, Ami Pro, Freelance Graphics, and cc:Mail

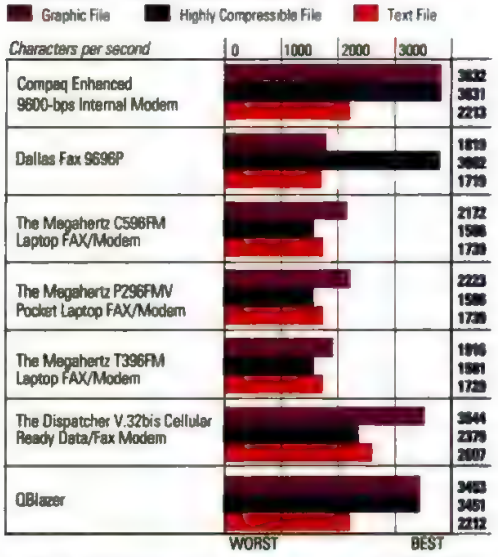
Development Corporation. Ami Pro is a trademark of Samna Corporation, a wholly-owned subsidiary of Lotus Development Corporation. cc:Mail is a trademark of cc:Mail, Inc., a wholly owned subsidiary of Lotus Development Corporation. Classic is a registered trademark trademark of Personal Training Systems, Inc. OS/2 is a registered trademark of International Business Machines Corporation. Macintosh is a registered trademark of Apple Computer, Inc.

Benchmark Tests: Portable Modems

A good, inexpensive, convenient traveling modem is not necessarily impossible. The best external modems are slightly more trouble to pack than internal modems, but much more portable than desktop modems. Internal modems are more convenient, but except for the Compaq, they all have some noticeable drawbacks.

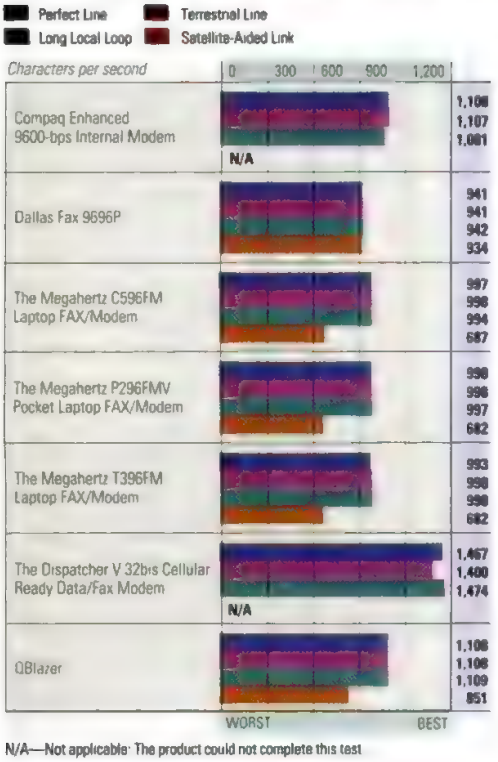
COMPRESSIBLE FILES

Perfect Line Conditions



INCOMPRESSIBLE FILE

Differing Line Conditions



N/A—Not applicable: The product could not complete this test

The first group of tests use **Compressible Files.** We send three files with varying levels of compressibility over a telephone line configured to simulate perfect line conditions. The various files test different components of the modem. Each file contains at least 1 million bits of information, enabling us to determine the modem's performance reliably.

- The graphics file, 663,063 bytes long, is a TIFF file containing a line drawing. Over the entire file, the compressibility is 5.3:1, but in the first 100K the file compresses at 11:1. This file tests the modem's ability to shift from high compressibility to moderate compressibility.
- The highly compressible file, 609,289 bytes, contains the string "THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 0123456789" repeatedly. This file is the most compressible, with a compression ratio of 22:1, and thus stresses the modem's compression algorithm.
- The text file, 469,341 bytes, contains a section of English text from a Ziff-Davis publication. Its compression ratio is 2.2:1. This file's main purpose is to show how the modem performs with actual text. It stresses the data pump and the V.42bis compression algorithm equally.

The **Incompressible File** tests use a completely incompressible 125,000-byte file created with a random generator. We send this file out over four types of line conditions:

- a perfect line (testing the data pump, and yielding scores that can be used as a standard of reference);
- a poor coast-to-coast terrestrial connection with a half-mile local loop between the central telephone office and the subscriber;
- a slightly better coast-to-coast land connection with a long, 6-mile local loop between central office and subscriber;
- a fairly typical satellite-aided coast-to-coast link.

HOW WE TESTED

At one end of our test-bed, we used a Compaq Deskpro 386/33L connected to a Motorola Codex 3260 modem as the host. At the other end, as the guest, we used another Compaq Deskpro 386/33L with each external portable modem we were testing. For each internal modem, the guest machine was a laptop corresponding to the modem's hardware requirements: a Toshiba T2000/40 for The Megahertz T396FM Laptop FAX/Modem, and a Compaq LTE 386s/20 for all of the others (the Compaq Enhanced 9600-bps Internal Modem, The Megahertz C596FM Laptop FAX/Modem, and The Dispatcher V.32bis Cellular Ready Data/Fax Modem).

The host PC ran Professional YAM, Version 17.89, using the Zmodem protocol to send the files to the guest PC; the guest ran ZD Labs' own GETZ program, which timed the transfer. We wrote GETZ to avoid any slowdowns from either of two causes: communications programs practicing *safe disk* (blocking the reception of data during file transfers) or the code in the disk controller causing the serial-port chip to lose data.

Our telephone simulator consisted of a Processing Telecomm Technologies (PTT) 5101 Central Office Simulator modified by PTT to conform to the new Telecommunications Industry Association specification, plus two PTT 5151 Impairment Simulators wired in bidirectional-impairment mode and a PTT 5200 Cable Simulator with local-loop simulator cards installed. An HP 4947A Transmission Impairment Measurement Set (TIMS) ensured that the simulator was working as expected throughout the test series.

Before testing, ZD Labs configured each modem for maximum performance. The vendors approved the configurations, making any changes they felt were needed. Once the modems were set up, we checked that they could each obtain maximum throughput without data errors before we actually tested them.

In each case, we used a Motorola Codex 3260 modem at the other end of the connection. For further information on the test equipment, call Processing Telecomm Technologies at 205-837-7880.

The test results, expressed in characters per second (cps), include all the overhead required to send the data, including the header, data link escape, and CRC characters. These scores do not include the Zmodem overhead, typically under 1.5 percent, which results from sending the directory information for each file.

OLICOM MAKES TOKEN-RING NETWORKS MORE COMPATIBLE

This advertisement: complete system solutions

So your accounting guy insists on using his new 486, your engineers won't part with their UNIX workstations and the IS department just upgraded their mainframe. And now you're supposed to get them all on your Token-Ring network? In the interest of peaceful relations, we'd like to recommend a solution from the leader in Token-Ring compatibility: Olicom.

We offer a full line of Token-Ring products for complete system-wide solutions, including bridges, adapters and cabling components. Our 16/4 Mbps adapter drivers support network operating systems from IBM, Novell, Microsoft and Banyan.

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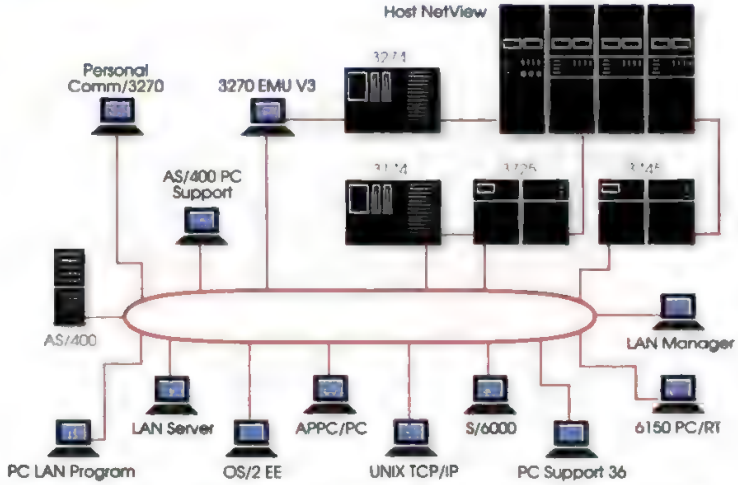
Olicom is already the second largest Token-Ring supplier in Europe (trailing only IBM) and a fast-growing presence in the United States. Our Token-Ring offerings support all industry-standard network operating systems. And all our products are 100% IBM compatible and inter-operable.

About the only thing that separates our products from theirs is our superior price/performance. After all, you have to be a little better when you're not so Big.



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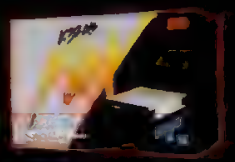
For just a little more, you can add caller ID and voice capabilities later this year. All this for the *dynamite* price of $399.95! In addition to the stand-alone version (without software) SupraFAXModems are available in Windows™, DOS™, and Macintosh™ packages.

SUPRA FAXMODEM V.32bis

Supra Corporation



9600 bps Version $299.95

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CIRCLE 191 ON READER SERVICE CARD

job and doing it well. Its careful design and engineering result in one of the best-performing internal modems we reviewed.

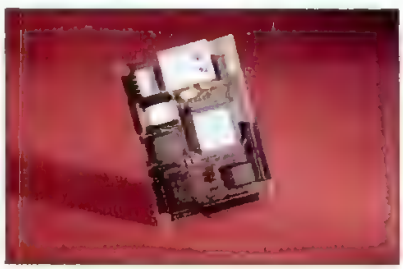
The bad news is that this $599 modem will work only in Compaq portables—specifically the LTE 386s/20, LTE Lite/20, LTE Lite/25, or Portable 486c. If you have some other computer, you'll have to look elsewhere. And while the modem includes some unusual features, such as support for both the Hayes and Microcom command sets, it does not offer any fax features or bundled software.

SUITABILITY TO TASK

Compaq Enhanced 9600-bps Internal Modem

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	●	●
Troubleshooting	●	●	○	○
Software compatibility	●	●	●	●
Portability	N/A			

The Compaq modem was one of two V.32 modems that stood out for its speed on our performance tests; the other was the QBlazer. The Compaq modem worked without problems with every software program we tried.



FACT FILE

Compaq Enhanced 9600-bps Internal Modem

Compaq Computer Corp., 20555 SH 249, Houston, TX 77070; 800-345-1518, 713-370-0670; fax, 713-374-1740

List Price: $599.

Requires: Compaq LTE 386s/20, LTE Lite/20, LTE Lite/25, or Portable 486c.

In Short: The Compaq internal modem offers a few extras, like the V.25bis command set and Hayes auto-sync mode. More interesting is that the modem obeys both Hayes and Microcom commands for advanced features. Most important, it scored well on our performance tests.

463 ON READER SERVICE CARD

PCMCIA: *A Great Standard, But Where Are the Products?*

by Angela Gunn

Sometimes good ideas go awry, and sometimes they don't go anywhere. Take the curious case of the PCMCIA specification—the industry standard for 2- by 3-inch add-in cards for portable computers, whose time came long before products were available.

The Personal Computer Memory Card International Association (PCMCIA) has over 150 members, including Apple Computer, Fujitsu America, Hewlett-Packard Co., IBM, Intel, Megahertz Corp., Motorola, Toshiba America Information Systems, and Zenith Data Systems. The specification defines a standard slot for credit card–size versions of the add-in cards that most users want (such as modems, LAN adapters, and memory expansion cards).

Intel's Modem 2400+ fits into a PCMCIA slot.

These slip-in cards are incredibly small. They eliminate the nuisance of bulky modems and external LAN adapters in already weighty laptop cases. Vendors could include slots on their laptops, and users could select from the promised products.

The concept of an add-in slot standard for laptops is not new. Toshiba based a modem slot in its T2200SX around the Japan Electronic Industry Development Association (JEIDA) standard, which also specified a small peripheral slot. But the PCMCIA did not adopt JEIDA, and Toshiba's attempt to force an industry standard failed. The PCMCIA standard was truly set by the consortium of industry leaders.

The problem is, even an industry-standard PCMCIA slot is useful only when there are cards to drop into the slot. So far, the shelves are effectively empty; Toshiba states that third-party vendors are four to six months behind their ship dates. The plethora of products has not materialized.

PCMCIA-compatible add-in cards are hardly the first computer products to ship late. But the world might not be willing to wait. The makers of both LAN adapters and modems—the two implementations most often touted as the best reason for PCMCIA and likely to make it to market before memory cards—have found other ways to insinuate their products onto your laptop.

The portable modems we've seen in this review are light and unobtrusive enough for most laptop users. For example, the Megahertz modem for Compaq laptops measures only 2.5 by 3.4 inches. Sure, PCMCIA cards are less bulky than external modems, but the computer maker must either build in the RJ-11 line adapter module elsewhere on the machine, as AT&T does, or leave an ungainly RJ-11 connector hanging off the back end of the computer, as Toshiba does.

In addition, the fastest available PCMCIA modems still reach only 2,400 bps. V.32 and V.32bis versions probably won't reach the market until the third quarter of this year. There is hope in another area, however. Apple is using a superset of PCMCIA to add software and data to the Apple Intelligent Assistant, its palmtop computer slated to ship next January. Though this in itself is not entirely useful for PC owners, it does encourage development of PCMCIA applications. But the market may have been ready too far in advance to wait for PCMCIA modems. □

▶ SUMMARY OF FEATURES

Portable High-Speed Modems

The modems we reviewed offer a similar level of basic functionality. All of them use the standard Hayes AT commands, support software and hardware flow control, and provide dial-tone or busy-signal detection and V.22, V.22bis, and V.32 modulations. None of the modems have volume controls or data/voice switches.

Products listed in alphabetical order by company ■ = YES ☐ = NO	**Compaq Computer Corp.** Compaq Enhanced 9600-bps Internal Modem	**Dallas Fax Inc.** Dallas Fax 9696P	**Megahertz Corp.** The Megahertz C596FM Laptop FAX/Modem	**Megahertz Corp.** The Megahertz P296FMV Pocket Laptop FAX/Modem	**Megahertz Corp.** The Megahertz T396FM Laptop FAX/Modem	**Piiceon Inc.** The Dispatcher V.32bis Cellular Ready Data/ Fax Modem	**Telebit Corp.** QBlazer
List price	$599	$379	$669	$669	$699	$979	$599
General Information							
Fax capability	☐	■	■	■	■	■	☐
Cellular capability	☐	☐	☐	☐	☐	■	☐
Warranty period	1 year	Lifetime	5 years	5 years	5 years	Lifetime	2 years
Communications software bundled with modem	None	MTEZ, QuickLink II, or Winfax	MTEZ	MTEZ	MTEZ	MTEZ	MTEZ
Physical Features							
Modem type	Internal	External	Internal	External	Internal	Internal	External
Dimensions (HWD, in inches)	N/A	0.9 x 2.4 x 4.3	N/A	1.2 x 2.4 x 3.3	N/A	N/A	2.3 x 2.5 x 2.5
Weight including batteries (in ounces)	N/A	5.5	N/A	6.5	N/A	N/A	8
Number of LEDs	N/A	1	N/A	None	N/A	N/A	8
Location of power switch	N/A	Right side	N/A	None	N/A	N/A	Right side
Number of predefined setup strings	1	2	2	2	2	2	1
Number of user-definable setup strings	2	2	2	2	2	2	2
Customization and Usage							
Amount of buffer memory for transmitting and receiving	380 bytes	32K	4K	4K	4K	2K	512 bytes
Two-wire leased-line capabilities	☐	■	■	■	■	■	☐
Synchronous mode	■	☐	☐	☐	☐	☐	☐
Hayes auto-sync mode	■	■	☐	☐	☐	■	☐
CCITT Modulation Protocols Supported							
V.21	■	■	■	■	■	■	☐
V.23	■	■	■	■	■	■	☐
V.32bis	☐	☐	☐	☐	☐	■	☐
Miscellaneous							
Most similar modem	Hayes' Ultra 96	Microcom AX	Microcom AX	Microcom AX	Microcom AX	Microcom AX	WorldPort 2400
Supports V.25bis command set	■	☐	☐	☐	☐	■	☐
Carrying case provided	☐	☐	☐	■	☐	☐	■
2,400-bps data-only modem available	■	☐	■	■	■	■	☐
2,400-bps-data and 9,600-bps-fax modem available	☐	■	■	■	■	■	☐

N/A—Not applicable. This product is an internal modem.

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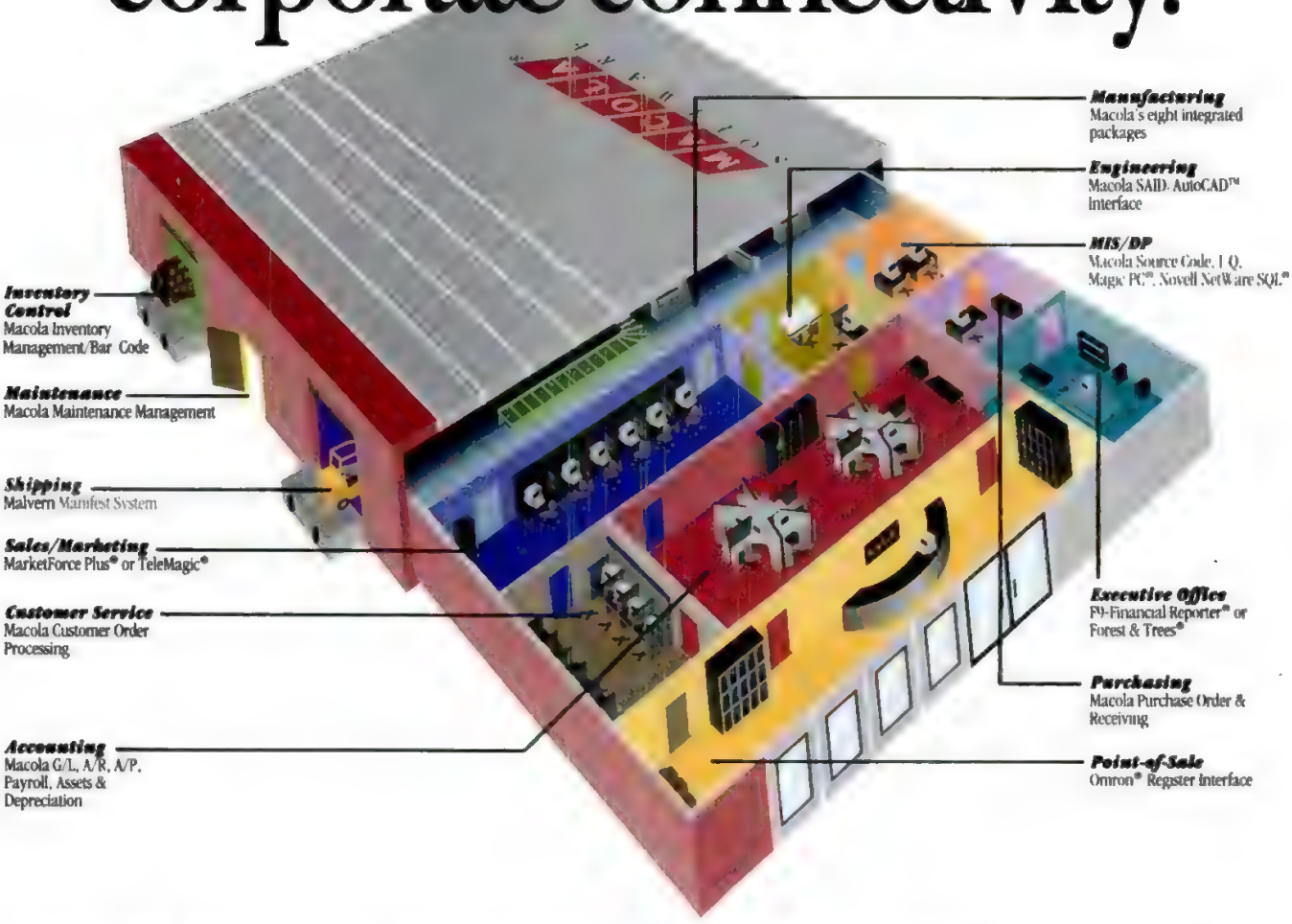

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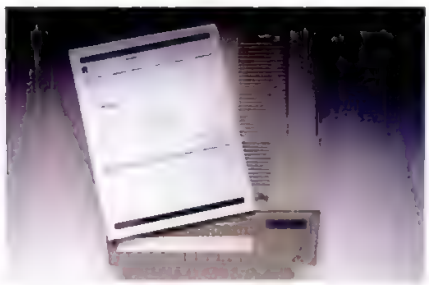

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System Requirements: 386SX, 386, 486SX or 486 PC with a mouse and a hard disk with at least 20MB free; 4MB RAM; Windows 3.0 or 3.1 and DOS 3.1 or later; Intel SatisFAXtion, The Complete Fax, The Complete Communicator, or CEI proFAX fax card.

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Moreover, the Compaq is the only modem in the current batch that supports the CCITT V.25bis command set used in Europe. This set of automatic calling and answering commands is not often used in the United States.

It's also one of three modems to offer the Hayes auto-sync mode; the other two are the Dallas Fax and Piiceon entries. Auto-sync will be of interest mainly to the comparatively few users who need synchronous communications (such as mainframe users who need synchronous modem links).

As previously mentioned, the package lacks bundled software and fax capability. But software is available elsewhere, and none of the modems with a fax feature measure up in data communications performance.

The modem supports the usual set of modulation, error-control, and data-compression protocols. Of far more general interest is Compaq's unusual approach to command sets. Since the modem does support both Hayes and Microcom commands simultaneously, it's effectively bilingual for commands that control advanced features like error control and data compression. Because you can give it commands with either command set, you should have no trouble getting it to work with virtually any communications software.

The manuals for the modem are typical for Compaq: well written and heavily illustrated where appropriate. They do not offer much background on communications features, but they carefully explain the modem commands.

If you want an internal modem and you have one of the Compaq laptop or notebook models this modem fits, it would be hard to justify any other choice—unless you just can't live without fax capability.

Dallas Fax Inc.

Dallas Fax 9696P

Smallness is a plus for portable modems. Of the three external modems reviewed here, the Dallas Fax 9696P takes home the prize for most portable, if only by a small margin. Weighing in at 5.5 ounces with a 9-volt battery, or about 1 ounce less than its closest competitor, the 9696P measures a scant 0.9 by 2.4 by 4.3 inches. That makes it a little longer than the second-place Megahertz P296FMV Pocket Laptop FAX/Modem, but also a little thinner. Although it's the longest external modem, it's only about the size of a large radar detector.

SUITABILITY TO TASK

Dallas Fax 9696P

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	○	○
Troubleshooting	●	○	○	○
Software compatibility	●	●	●	○
Portability	●	●	●	○

The 9696P is a mail-order machine with a list price of $379 (including the software, a short serial cable, and a small case), which means that it is also the least expensive modem in this group. The low price buys most of the features you might need, although with somewhat slower

MultiModem µ: High Speed, Fax, and More

by M. David Stone

Multi-Tech Systems' MultiModem µ (Greek letter mu) is designed to give you cutting-edge technology. This unit, which was in a beta version at the time of our review, carries a high price tag ($899, with an expected street price of $600). But you get Class 2 fax support for background faxing, great performance thanks to V.32bis/V.42bis capability, and a hefty bank of LEDs.

With Class 2 technology, much of the work involved in faxing is offloaded onto the modem's processor. Other fax modems reviewed here adhere to the Class 1 standard, which uses the computer's processor for all the work of sending and receiving faxes. With Class 2 and the MultiModem µ's bundled fax software—MEFAX (for "Multi-Express Fax"), Version 2.0—faxing can occur in the background.

The MultiModem µ offers Bell 103 and 212, V.22, V.22bis, and V.32 modulation protocols. Slightly different models available in other countries will add V.21 and V.23 protocols. You'll also find the usual error-control and data-compression protocols.

Also included is Multi-Tech's Multi-Express, Version 1.03, a full-function communications program similar to Procomm Plus that also includes both the terminal and host modules for remote-control operation. The host module, running on your office PC, can work with most modems, according to Multi-Tech.

One other noteworthy touch is a bank of 12 status lights. These include the usual choices (send data, receive data, off-hook, carrier detect, and terminal ready), plus 4 lights to indicate speed (14,400, 9,600, 2,400, and 1,200 bps); there is also one light for a fax connection, one for battery status, and one to indicate data compression (illuminated when error control is off, blinking when error control is on). The labels on the beta unit were too small to read, but Multi-Tech says this will be fixed in the production version.

Cramming all this functionality into a modem takes space, and the MultiModem µ's size reflects that demand. At roughly half the size of a typical desktop modem, it is surprisingly large for a portable. And at a hefty 10 ounces, complete with 9-volt battery and attached serial cable, it's heavier than the other modems we reviewed.

You may also have trouble using some software, because of Multi-Tech's distinctive command set and response codes. In our tests, we could not fully take advantage of data compression with Smartcom III, because the modem's response codes differed from the Hayes responses the software expected.

The modem also had trouble working with Relay Gold for DOS when the software was set for a Hayes modem. It had no trouble when the software was set for a Multi-Tech modem, however, and the modem worked flawlessly with Crosstalk XVI, Lotus Express, Multi-Express, and Procomm Plus.

Finally, the modem did well on our performance tests, turning in results appropriate for a V.32bis modem. That differs sharply from the other modems with fax capabilities, all of which performed on the low side of average. And this alone is ground enough to take the Multi-Tech entry seriously if you want a fax feature. □

FACT FILE

MultiModem µ

Multi-Tech Systems Inc., 2205 Woodale Dr., Mounds View, MN 55112; 800-328-9717, 612-785-3500; fax, 612-785-9874

List Price: With attached serial cable with DB-9 connector, DB-9-to-DB-25 adapter, modular-plug phone cable, AC adapter, Multi-Express 1.03 (remote-operations software), MEFAX 2.0 (fax software), carrying case, $899.

Requires: RS-232 serial port.

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performance than the QBlazer offers.

The 9696P works with all of the communications programs we tested and with MTEZ. Unfortunately, its performance scores on our Incompressible File tests and two of our Compressible Files tests were somewhat below par. The 9696P was generally the slowest of the tested modems, although it handled the highly compressible file well and actually surpassed the other modems in transmitting the incompressible file over the satellite-aided link. Dallas Fax says it is providing newer AT&T firmware that should improve performance.

The 9696P provides Group III send/receive fax capability; it follows the Electronic Industries Association (EIA) Class 1 fax modem specification and ships, as tested, with MTEZ and ExpressFax software. It's also available with QuickLink II, a DOS-based program, or Winfax 2.0, an equivalent Windows-based program for faxing. MTEZ, a general-purpose communications program, will serve your needs if you don't already have a favorite program (for a review of MTEZ, see "Modem Communications Software: Too Hard to Use," June 30, 1992). Even if you do use another program for communications, you'll want one of these three programs, since they are among the few that support Class 1 fax modems.

While the 9696P handles most communications functions well, it cuts corners on troubleshooting. The modem lacks a speaker, status lights (other than a power light), and even a second connection where you might plug in a phone. As a result, everything that happens on the phone line is a complete mystery; if something goes wrong, you won't know why. A Dallas Fax spokesman says status lights and probably a speaker will be added.

The 9696P offers the typical set of U.S. and worldwide modulation, error-control, and data-compression protocols. The command set is based on Microcom rather than Hayes commands. It does include Hayes auto-sync mode.

A minor shortcoming is the manual,

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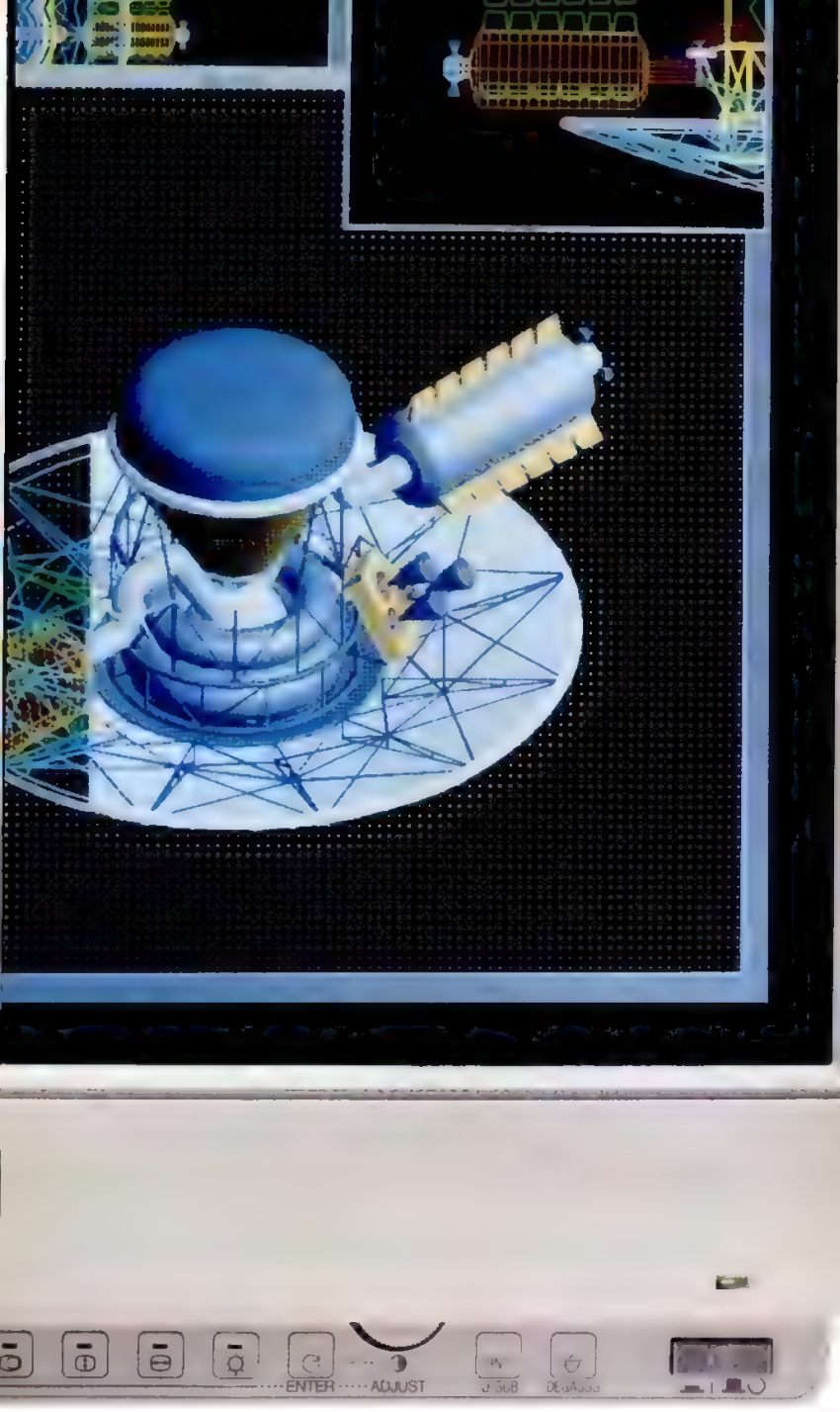

Come A Little Closer

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which contains some inaccuracies about the command set and tends toward techno-babble when explaining various settings. Dallas Fax says it plans to correct the manual's errors and also improve the syntax.

Overall, the Dallas Fax 9696P is a budget package at a budget price. The missing troubleshooting features and the performance levels are serious drawbacks. But for $379, you might decide that you can live with them.

FACT FILE

Dallas Fax 9696P

Dallas Fax Inc., 13771 North Central Expwy., #1001, Dallas, TX 75243; 800-876-8581, 214-699-8999; fax, 214-699-9079

List Price: With MTEZ and ExpressFax, AC adapter, serial cable with DB-9 connector and DB-9-to-DB-25 converter, modular phone cable, carrying case, $379.

Requires: RS-232 serial port.

In Short: At $379, the Dallas Fax 9696P offers the lowest price tag and high-speed communications. In the absence of a speaker and status lights, however, troubleshooting problems may be difficult.

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Megahertz Corp.

The Megahertz C596FM Laptop FAX/Modem
The Megahertz T396FM Laptop FAX/Modem

Internal or external? Megahertz Corp. covers both bases. The company is selling internal fax modems for AST, Compaq, Toshiba, and Zenith portable systems, and an external fax modem (The Megahertz P296FMV Pocket Laptop FAX/Modem, reviewed below). Although the test performance could have been better, these units offer convenient power-saving features.

The Megahertz C596FM Laptop FAX/Modem costs $669 and fits into a Compaq LTE 386s/20, LTE Lite/20, LTE Lite/25, or Portable 486c. The Megahertz T396FM

SUITABILITY TO TASK

The Megahertz C596FM Laptop FAX/Modem

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	○	○
Troubleshooting	●	●	○	○
Software compatibility	●	●	●	○
Portability	N/A			

Laptop FAX/Modem ($699) slides into a compatible Toshiba computer (the specific models are listed in the fact file). The T396FM will not fit into the Toshiba T2200SX or T3300SL, either of which requires a JEIDA card (see the sidebar "PCMCIA: A Great Standard, But Where Are the Products?"). But Megahertz expects to ship an internal V.32bis modem for these computers during the third quarter of this year. Internal modems for the AST Premium Exec series and several Zenith models, also priced at $699, were not available in time for review.

The internal and external modems are similar in features and behavior, and their

SUITABILITY TO TASK

The Megahertz T396FM Laptop FAX/Modem

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	○	○
Troubleshooting	●	●	○	○
Software compatibility	●	●	●	○
Portability	N/A			

performance proved almost identical. They worked with all of the programs we tried and with MTEZ, the program they ship with. The results on our performance tests were on the low side of average for V.32 modems, but newer firmware Megahertz is adding to these modems should increase their throughput rate.

One notable exception: The Toshiba T2000/40 we used for testing could not make the most of the T396FM. We had to slow down the other serial port (the port not connected to the modem) to perform some of our tests. The Toshiba T2000 uses an 8250-compatible custom UART (Uni-

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CIRCLE 105 ON READER SERVICE CARD

2,400-bps Portable Modems: What's Out There

COMPILED BY SUSAN G. THOMAS

Company	Product	Type	Data compression
Compaq Computer Corp.	Compaq 2400-bps Internal Modem	Internal	None
	Compaq Enhanced 2400-bps Internal Modem	Internal	V.42bis, MNP 5
The Complete PC Inc.	The Complete Portable Plus	External	V.42bis, MNP 5
Dallas Fax Inc.	Dallas Fax DF2496E	External	None
	Dallas Fax DF2496EV	External	V.42bis, MNP 5
	Dallas Fax DF2496P	External	V.42bis, MNP 5
Frecom, a subsidiary of CXR Corp.	CXR 2424	External	V.42bis, MNP 5
	CXR 2443	Internal	V.42bis, MNP 5
	Freecom FAX96	Internal	V.42bis; MNP 5, 7
GVC Technologies Inc.	GVC FMM9648/24	External	None
	GVC FMM9696/24	External	None
	GVC FMM9696/24V	External	V.42bis, MNP 5
	GVC MM24	External	None
Hayes Microcomputer Products Inc.	Hayes Pocket Edition 2400	External	None
Logicode Technology Inc.	Quicktel 9624LP	External	V.42bis, MNP 5
Megahertz Corp.	Megahertz AR124FM	Internal	V.42bis, MNP 5
	Megahertz AR124M	Internal	V.42bis, MNP 5
	Megahertz C524FM	Internal	V.42bis, MNP 5
	Megahertz C524M	Internal	V.42bis, MNP 5
	Megahertz P224FMV Pocket Laptop FAX/Modem	External	V.42bis, MNP 5
	Megahertz P224SF	External	None
	Megahertz P224SFM Pocket Laptop Modem	External	V.42bis, MNP 5
	Megahertz T324FM	Internal	V.42bis, MNP 5
	Megahertz T324M	Internal	V.42bis, MNP 5
	Megahertz TX324FM	Internal	V.42bis, MNP 5
	Megahertz Z324FM	Internal	V.42bis, MNP 5
	Megahertz Z324M	Internal	V.42bis, MNP 5
Micro Integrated Communications Corp. (MiCC)	MiCC Internal Modem	Internal	V.42bis, MNP 5
Microcom Inc.	MicroPort 542	External	V.42bis, MNP 5
	MicroPort 1042	External	V.42bis, MNP 5
OmniTel Inc.	OmniTel Business Card 2496C	Credit-card	V.42bis, MNP 5
	OmniTel World Card 2496C+	Credit-card	V.42bis, MNP 5
Piiceon Inc.	Piiceon 8052496	Internal	V.42bis, MNP 5
	Piiceon 8082496	Internal	V.42bis, MNP 5
Practical Peripherals Inc.	PM2400PPM V.42	External	V.42bis, MNP 5
Solectek Corp.	Solectek FM-W	External	V.42bis, MNP 5
Toshiba America Information Systems Inc.	Toshiba T24D	Internal	None
	Toshiba T24D/X	Internal	V.42bis, MNP 5
	Toshiba T24M	Credit-card	MNP 5
	Toshiba T24SL	Credit-card	MNP 5
U.S. Robotics Inc.	WorldPort 2400	External	None
	WorldPort 2400 V.42bis	External	V.42bis, MNP 5
	WorldPort 2405i V.42bis	Internal	V.42bis, MNP 5
	WorldPort 2496 Fax/Data Modem	External	V.42bis, MNP 5
	WorldPort 2496i-T	Internal	None
	WorldPort 2496i-V.42bis	Internal	V.42bis, MNP 5
Ven-Tel Modems	Ven-Tel Pocket Modem	External	None

N/A—Not applicable: The product does not offer fax capabilities of this type

Fax speeds (bps): Send	Receive	Computer type	Price	Telephone number
N/A	N/A	Compaq LTE, LTE/286	$249.00	800-345-1518
N/A	N/A	All Compaq laptops	$319.00	
9,600	9,600	Any laptop	$299.00	800-634-5558
9,600	9,600	Any laptop	$120.00	800-876-8581
9,600	9,600	Any laptop	$130.00	
9,600	9,600	Any laptop	$139.00	
N/A	N/A	Any laptop	$585.00	800-537-5762
N/A	N/A	Any laptop	$585.00	
9,600	2,400	Any laptop	$139.00	
9,600	4,800	Any laptop	$159.00	800-289-4821
9,600	2,400	Any laptop	$199.00	
9,600	2,400	Any laptop	$249.00	
N/A	N/A	Any laptop	$109.00	
N/A	N/A	Any laptop	$179.00	404-840-9200
9,600	4,800	Any laptop	$299.00	805-499-4443
9,600	2,400	AST Premium Exec 386SX/20/25/25C	$429.00	800-527-8677
N/A	N/A	AST Premium Exec 386SX/20/25/25C	$289.00	
9,600	2,400	Compaq LTE 386s/20, 486c, LTE Lite/20/25	$429.00	
N/A	N/A	Compaq LTE 386s/20, 486c, LTE Lite/20/25	$289.00	
9,600	9,600	Any laptop	$379.00	
4,800	2,400	Any laptop	$189.00	
4,800	N/A	Any laptop	$239.00	
9,600	2,400	All Toshiba laptops except T2200SX/3300	$429.00	
N/A	N/A	All Toshiba laptops except T2200SX/3300	$239.00	
9,600	2,400	All TI TravelMate laptops, WinSX; Sharp 5220/6641	$429.00	
9,600	2,400	All Zenith laptops	$429.00	
N/A	N/A	All Zenith laptops	$289.00	
9,600	9,600	Any laptop	$199.00	800-282-6422
N/A	N/A	Any laptop	$449.00	617-551-1000
N/A	N/A	Any laptop	$649.00	
9,600	9,600	Any notebook with a PCMCIA Type 2 slot	$399.00	510-490-2202
9,600	9,600	Any notebook with a PCMCIA Type 2 slot	$449.00	
9,600	9,600	Compaq 386s/20, LTE Lite	$379.00	408-432-8030
9,600	9,600	All Toshiba laptops except T2200SX/3300	$379.00	
9,600	N/A	Any laptop	$229.00	800-442-4774
9,600	4,800	Any laptop	$349.95	800-437-1518
N/A	N/A	All Toshiba laptops except T1000/3100/3200/5200	$199.00	800-999-4273
N/A	N/A	All Toshiba laptops except T1000/3100/3200/5200	$259.00	
N/A	N/A	Toshiba T2200SX	$459.00	
N/A	N/A	Toshiba T3300SL	$459.00	
N/A	N/A	Any laptop	$229.00	800-342-5877
N/A	N/A	Any laptop	$349.00	
N/A	N/A	All Toshiba laptops except T1000/3100/3200/5200	$299.00	
9,600	9,600	Any laptop	$379.00	
9,600	9,600	Toshiba T1100+/1200/1600/3100/3100SX/5100/5200	$449.00	
9,600	9,600	All Toshiba laptops except T1000/3100/3200/5200	$499.00	
9,600	N/A	Any laptop	$189.00	800-538-5121

versal Asynchronous Receiver/Transmitter) that has no FIFO (first in, first out) buffer, so the modem will drop data if you try to run it at high DTE speeds (data terminal equipment or modem-to-computer speeds). The modem probably would have performed better with a 16550A UART in the computer.

The C596FM and T396FM weigh 1.9 ounces each. One welcome feature: Either one automatically powers down to save your portable system's battery when you are not using the modem.

Neither internal modem includes a speaker on-board. Instead, the modems let you listen to call progress through the system's speaker. There is no way to adjust the volume; the only choice is to turn the speaker on or off. The modems return an OK in response to the standard Hayes command for volume control, however, ensuring that any program that tries to control the volume will get an OK rather

FACT FILE

The Megahertz C596FM Laptop FAX/Modem

The Megahertz T396FM Laptop FAX/Modem

Megahertz Corp., 4505 Wasatch Blvd., Salt Lake City, UT 84124; 800-527-8677, 801-272-6000; fax, 801-272-6077

List Price: With MTEZ with ExpressFax, modular phone cable, $699.

C596FM Requires: Compaq LTE 386s/20, LTE Lite/20, LTE Lite/25, or Portable 486c.

T396FM Requires: Toshiba T1000SE/XE/LE, T1200-series, T1600, T2000-series, T3100SX, T3200SX/SXC, T4400SX/SXC, or T6400-series computer.

In Short: The internal Megahertz modems are almost identical to the external Megahertz modem in features and performance, and both include a fax capability. A welcome touch is a power-down feature that saves your portable system's battery power.

485 ON READER SERVICE CARD

than an error message.

The Megahertz modems offer send and receive capabilities for Group III fax transmission, following the EIA Class 1 specification. They all come with MTEZ and ExpressFax, and a coupon for a free Windows fax software package will also be included. At press time, the company had not decided on which brand.

All three modems offer the usual modulation, error-control, and data-compression protocols, and they share identical command sets based on Microcom commands. The well-written, well-illustrated manuals are particularly helpful for installing the internal modems and taking the best advantage of data-compression and error-control features.

The street prices for these modems (as well as the AST and Zenith models) should range from about $500 to $550. The performance test results make them hard to recommend unconditionally, but they are acceptable if you need fax capability along with high-speed data communications.

Megahertz Corp.

The Megahertz P296FMV Pocket Laptop FAX/Modem

Despite its name, The Megahertz P296FMV Pocket Laptop FAX/Modem will not quite fit comfortably in a pocket. The permanently attached 8-inch serial cable is a little too bulky. The modem itself will fit, since it measures just 1.2 by 2.4 by 3.3 inches and weighs a comfortably light 6.5 ounces. It lacks a power switch and status lights, but it offers useful power-saving capabilities and an adjustable speaker.

SUITABILITY TO TASK

The Megahertz P296FMV Pocket Laptop FAX/Modem

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	○	○
Troubleshooting	●	●	○	○
Software compatibility	●	●	●	○
Portability	●	●	●	○

On our tests, the modem worked reliably with all of our comm software programs and also with MTEZ for both data and fax communications. The scores on our performance tests were on the low side of average for V.32 modems, although an upgraded EPROM in the latest run of Megahertz modems should help.

FACT FILE

The Megahertz P296FMV Pocket Laptop FAX/Modem

Megahertz Corp., 4505 Wasatch Blvd., Salt Lake City, UT 84124; 800-527-8677, 801-272-6000; fax, 801-272-6077

List Price: With MTEZ and ExpressFax, two AA batteries, AC adapter, serial cable with DB-9 connector, modular phone cable, carrying case, $669.

Requires: RS-232 serial port.

In Short: This Megahertz entry offers a Group III fax capability as well as V.32 data communications. The lack of status lights is a noticeable oversight, but the modem does have a speaker for troubleshooting problems.

466 ON READER SERVICE CARD

In many ways, the $669 Megahertz external modem is similar to the Dallas Fax entry. Both have a similar size, shape, and weight; both offer Group III send/receive fax capabilities following the EIA Class 1 EIA specification; both offer the typical modulation, error-control, and data-compression protocols; and both come with MTEZ software with ExpressFax and a coupon for free Windows fax software. Yet the modems have a number of differences.

The most important one is that the P296FMV includes a speaker, so you can track call progress and determine the cause of some communications problems. The speaker is too faint to hear in noisy environments, even at its loudest setting, but it's better than having none at all. Unfortunately, the P296FMV, like the Dallas Fax modem, lacks status lights, so the unit is still less than ideal for troubleshooting problems.

You won't find a power switch on the P296FMV. It will automatically power down, but not off, to save battery life when you are not using it. The modem uses two AA batteries, which come with the package.

The Megahertz command set is based on Microcom rather than Hayes commands for data compression and error control. The manual is well written and illustrated, so even communications novices should understand it. More advanced users will appreciate the discussion of data compression, error control, and optimizing the modem for these features.

Keep in mind that the price difference between the Megahertz and Dallas Fax modems is not as large as it seems. The $379 list price for the Dallas Fax 9696P is also the selling price. The $669 for the external Megahertz modem should translate to a street price of roughly $500 to $550.

Given the results on our performance tests, this package is difficult to recommend unreservedly. Still, The Megahertz P296FMV Pocket Laptop FAX/Modem is acceptable if you need fax capability and high-speed data communications.

Piiceon Inc.

The Dispatcher V.32bis Cellular Ready Data/Fax Modem

If you want a portable modem you can use anywhere, The Dispatcher V.32bis Cellular Ready Data/Fax Modem, from Piiceon (pronounced *pie-see-on*), provides an elegant solution for cellular phone connections, although an expensive one for standard lines. This $979 internal modem will work only with specific laptops and specific cellular phones, and its performance is middling for a V.32bis modem.

The Piiceon worked with all of our comm packages, as well as with MTEZ, the program that ships with it. Over standard connections, the modem performed

SUITABILITY TO TASK

The Dispatcher V.32bis Cellular Ready Data/Fax Modem

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	●	○
Troubleshooting	●	●	○	○
Software compatibility	●	●	●	○
Portability	N/A			

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PC World, April 1992*

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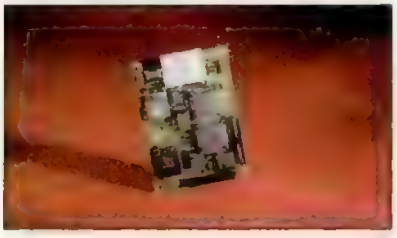
somewhat on the low side of average for a V.32bis modem at 14,400 bps. Naturally, its performance at 14,400 bps was sometimes faster than the performance of the V.32 modems, which ran at 9,600 bps. We did not test this unit at 9,600 bps or over cellular links.

The modem fits into a Compaq LTE 386s/20, LTE Lite/20, LTE Lite/25, and Portable 486c. For the same price, there is a version for Toshiba computers that include the Toshiba D slot.

The Piiceon modem does not plug directly into a cellular phone, but into a cellular interface that in turn plugs into a phone. The needed interface is found in Piiceon's $299 CellPort upgrade kit, which has a typical street price of about $250 and is available for various phone models from Audiovox, Motorola, NEC America, Oki Telecom, and Uniden.

Along with the 3- by 2-inch plastic interface, which has its own EPROM and battery, the upgrade kit contains some cables and a cellular module upgrade for MTEZ. That module includes MTEZ's modified MNP protocol to tolerate the momentary breaks in communication common over cellular connections. You'll also have to make allowances for those problems at the other end of the connection.



FACT FILE

The Dispatcher V.32bis Cellular Ready Data/Fax Modem

Piiceon Inc., 1996 Lundy Ave., San Jose, CA 95131; 800-366-2983, 408-432-8030; fax, 408-432-8960

List Price: With MTEZ and ExpressFax, modular phone cable, $979. CellPort upgrade kit, $299.
Requires: Compaq LTE 386s/20, LTE Lite/20, LTE Lite/25, or Portable 486c.
In Short: The Piiceon entry is an internal V.32bis modem that also offers send and receive Group III fax capability, an auto-sync mode, and a cellular-ready feature that requires the purchase of a cellular upgrade kit.
467 ON READER SERVICE CARD

The kit's telephone-specific nature means that you have to specify the phone manufacturer and model when you order the kit. If you get a different phone, you have to buy a different upgrade kit. According to Piiceon, this is unavoidable, the result of differences among cellular telephones.

Even if you ignore the cellular capability, the Piiceon modem is loaded with features, including Hayes auto-sync mode and Group III send/receive fax capabilities using the EIA Class 1 spec. It includes the usual modulation, error-control, and data-compression protocols. The command set follows Microcom rather than Hayes for data compression and error control.

The Piiceon entry is the only V.32bis modem in this batch, which partly explains why the price is so high ($979, with a typical street price of $750). The other

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CIRCLE 001 ON READER SERVICE CARD

Tektronix

modems use only V.32. But even the V.32 version of the Piiceon modem (The Dispatcher V.32 Cellular Ready Data/Fax Modem) is somewhat expensive, with a list price of $799 and a typical street price of $650. The reason, of course, is Piiceon's cellular-ready feature.

All told, the combination of high price with less than outstanding performance makes Piiceon a little too pricey if all you want is a standard modem. But if you are looking for a modem with fax capabilities, plus a simple solution for connecting to a cellular phone, it's certainly worth considering.

Telebit Corp.

QBlazer

Telebit's QBlazer trades a little portability for better performance. The QBlazer is neither as small nor as light as the other external modems reviewed here. Its nearly cubical shape, measuring 2.3 by 2.5 by 2.5 inches, doesn't even pretend to fit into a pocket, and its 8-ounce weight (with 9-volt battery, purchased separately) is about 2 ounces more than the next-heaviest external modem. But if the QBlazer loses some points for its extra weight and its lack of fax support, it more than compensates in performance.

SUITABILITY TO TASK

QBlazer

	POOR	FAIR	GOOD	EXCELLENT
File transfers	●	●	●	●
Troubleshooting	●	●	●	●
Software compatibility	●	●	●	○
Portability	●	●	●	○

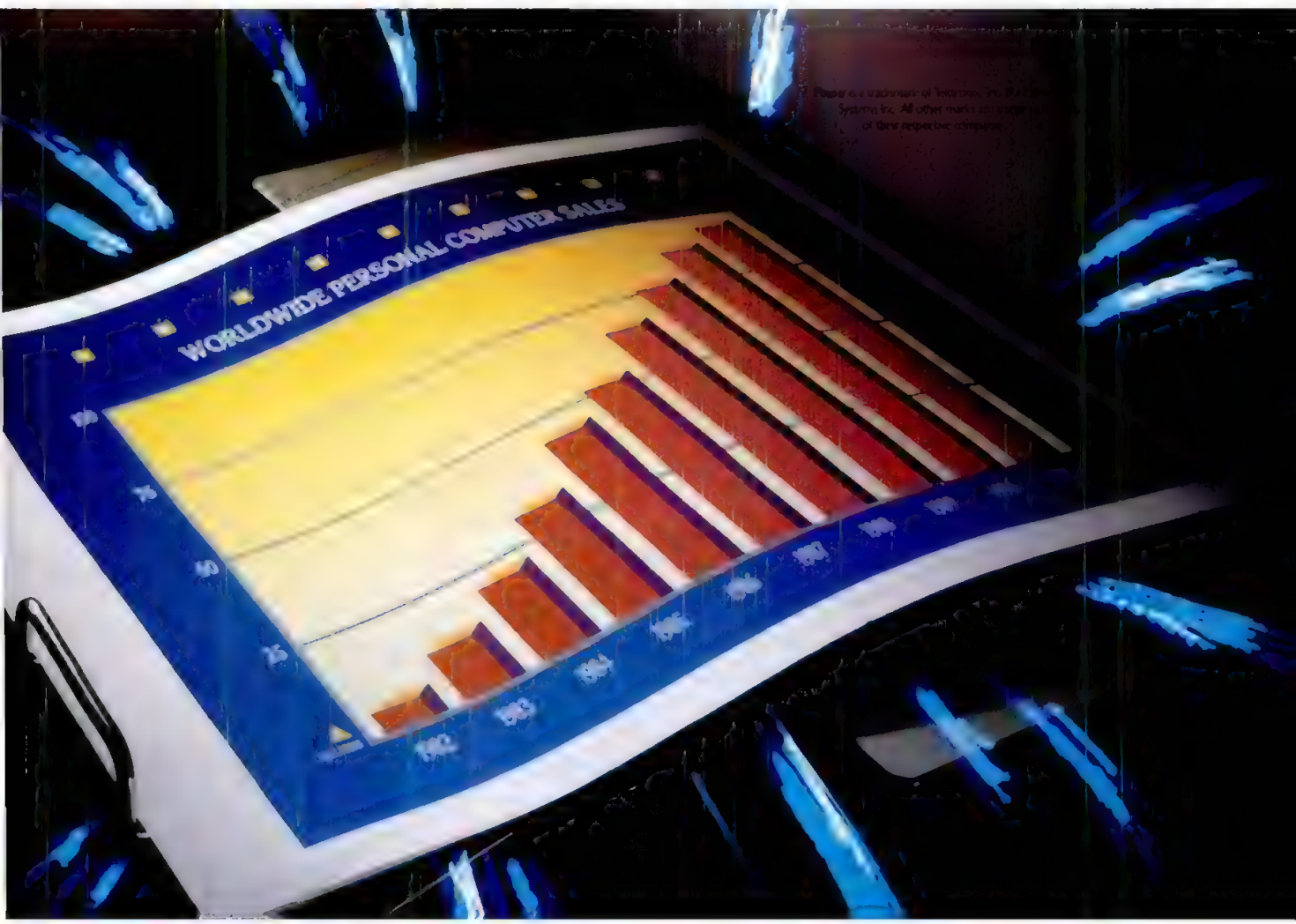
The $599 QBlazer, which has a street price of about $400, was one of the best-performing modems. Together with the Compaq Enhanced 9600-bps Internal Modem, it stood head and shoulders above the other V.32 modems on most of our performance tests. And that's far from the only plus.

The QBlazer worked with most of the programs we tried, including MTEZ, the program it ships with. But unlike the other modems, it did not work with early versions of Smartcom III designed only for Hayes modems and extremely close clones. (The current Smartcom III lets you fine-tune the software to work with other modems, like the QBlazer.) While this modem should work with most programs, make sure it works with any special-purpose program you have in mind.

A welcome feature, unusual in a portable modem, is a bank of eight status lights: send data, receive data, carrier detect, off-hook, terminal ready, modem ready, low battery, and error control. The error-control light blinks to indicate data compression—a particularly handy touch, since there is often no other way to tell whether you have established error control or data compression.

The QBlazer cuts a few corners. For example, you'll find Bell 103 and 212, V.22, V.22bis, and V.32 modulation protocols, but not V.21 or V.23. The missing protocols are not especially useful for most U.S. users. You will find the usual error-control and data-compression protocols.

The command set is best described as an extension of the Hayes Smartmodem



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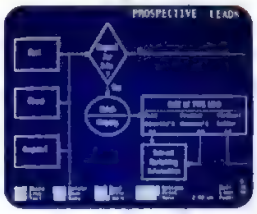

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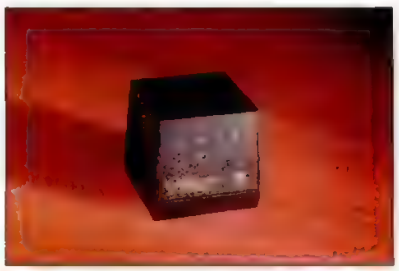

FACT FILE

QBlazer
Telebit Corp., 1315 Chesapeake Terrace, Sunnyvale, CA 94089; 800-835-3248, 408-734-4333; fax, 408-734-3333

List Price: With MTEZ, AC adapter, serial cable, modular phone cable, carrying case, $599.

Requires: RS-232 serial port.

In Short: While the nearly cubical design of the QBlazer makes it the wrong shape to fit easily in a pocket, it is still highly portable. More important, the QBlazer is the best-performing external modem in this roundup, and the only one to offer both a clearly audible speaker and a full set of status lights.

668 ON READER SERVICE CARD

2400 commands that follows neither Hayes nor Microcom for error control and data compression. The QBlazer supports these features, but it uses unique commands that will not conflict with programs designed for Hayes or Microcom commands. Most programs don't send these commands by default; if they do, the worst the modem will do is produce an error message.

The package includes a host of small, helpful touches, such as the well-written manual, which does an excellent job of explaining how to use the command set, and an oversize carrying case for the modem, power supply, and phone cable.

Perhaps the only important missing feature is fax. Since none of the modems with fax capabilities measure up in data throughput, you're left with a choice between fax capability and relatively fast data communications. And for data communications, the QBlazer earns a wholehearted recommendation. ☐

FRANK J. DERFLER, JR., IS SENIOR NETWORKING EDITOR OF *PC MAGAZINE*. M. DAVID STONE IS A CONTRIBUTING EDITOR TO *PC MAGAZINE*. ANGELA GUNN IS A RESEARCHER/REPORTER OF *PC MAGAZINE*.

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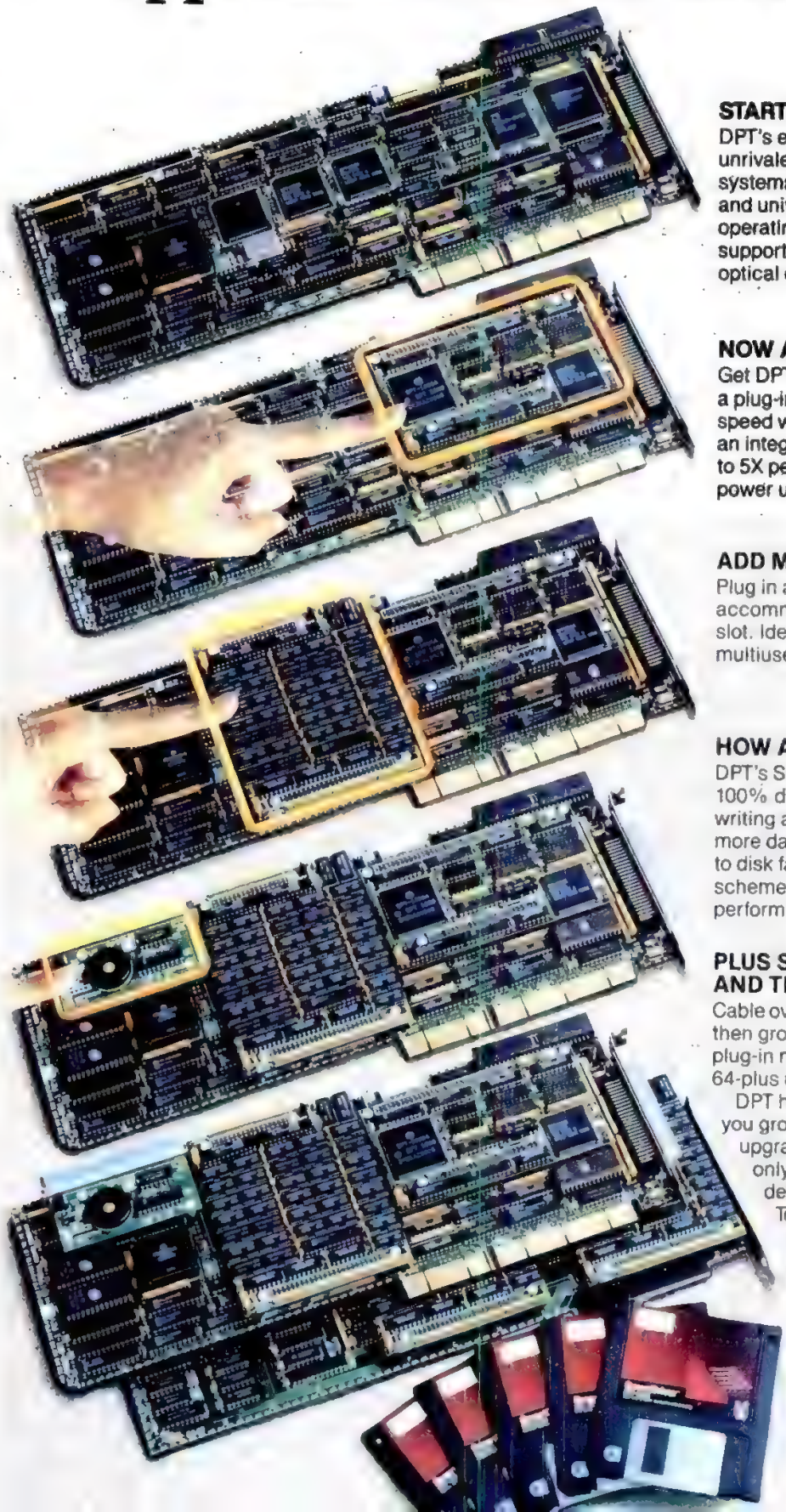

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SYMBOLIC MATH SOFTWARE

It's Not Just for Mainframes Anymore

Mathematicians have traditionally sacrificed software ease of use to the deity of accurate mathematical solutions. Now more than ever before, PC-based mathematical problem solving stands poised to strike a delicate balance between raw computational power and a carefully crafted interface.

The first digital computers grew out of the needs of World War II weapons manufacturers and radar engineers who were trying to cope with the overwhelming calculational demands of their trades. After the war, they decided there must be an alternative to rows of human beings using the increasingly inadequate adding machine methods; hence the computer was born. Scientists and mathematicians have since remained at the cutting edge of calculation-intensive computing, often using supercomputers to provide them with the processing power they demand.

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ILLUSTRATION BY JEAN TUTTLE

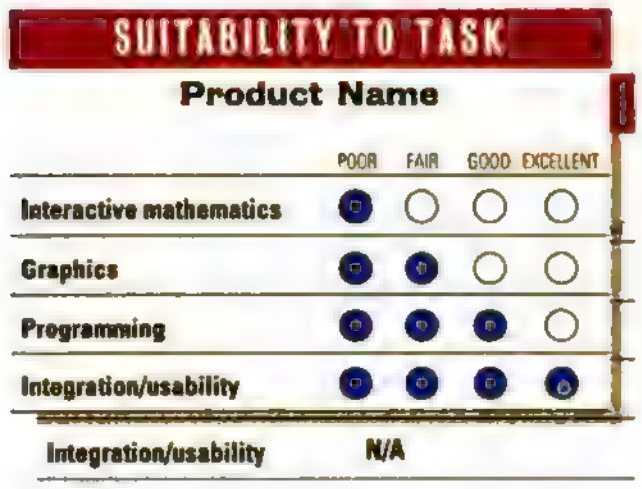
by Barry Simon

Suitability to Task: Symbolic Math Software

Symbolic math software is an ever-evolving category. Even though these packages perform wondrous feats, there is room for improvement in the basic mathematical functioning of even the best packages in this group. Impending Microsoft Windows versions of Maple V and Reduce promise to bring increased graphics power and complete integration to these packages. We rated five symbolic math packages for their usefulness in four general areas.

Interactive mathematics evaluates the quality of the software package's built-in functions in terms of their scope of functionality, accuracy, ability to solve difficult problems on our test suite, and speed.

Graphics evaluates the scope, quality, and flexibility of a program's graphics toolbox—in those products that provide one.



N/A—Not applicable: The product does not perform this task.

Programming reflects the extensiveness of a package's programming constructs, the quality of its error messages, its debugging capabilities, its links to other programs (for example, via DDE), and its pattern-matching prowess.

Integration/usability evaluates the quality of a package's user interface, its ability to translate formulas automatically to TeX or C for printing, and its ability to save graphics in standard bitmapped and vector formats.

Unfortunately, processing time on state-of-the-art mainframe systems is still so expensive that you are forced to work through calculations in batch mode. For many projects, the most fruitful mode of operation is a dialogue with the machine where you see the result of each small step and use that result to figure out the next step. As desktop systems acquire the computing power of yesterday's mainframes, scientists who are anxious to work in this interactive way are turning to PCs more frequently. And scientists are not the only ones who need to perform high-power mathematical computations on a PC; economists, financial analysts, engineers, medical researchers, and statisticians often have similar needs.

Among the several generic categories of math software (including number-crunchers—*super calculators* or *scratchpads*—and equation/model solvers), the symbolic manipulation packages examined in this issue are the most spectacular. Those who have been following this field since the earliest days of PC-based solutions will be amazed to find that it's actually possible to automate some of the operations that these packages do.

In this review, we'll be looking at the PC-based symbolic math packages that have been introduced or significantly upgraded since our last review ("Software: The New World of Higher Math," *PC Magazine*, May 29, 1990): Soft Warehouse's Derive: A Mathematical Assistant, Version 2.1; Waterloo Maple Software's Maple V, Version 1.1; Wolfram Research's Mathematica for DOS, Version 2.0, and Mathematica for Windows, Version 2.0; and Calcode Systems' Reduce, Version 3.4. The timing of this article inadvertently favors Mathematica, which recently received a major upgrade to its kernel and is also the first out of the gate with a Microsoft Windows version. Waterloo Maple is planning to ship Maple V, Version 2.0, its kernel upgrade and Windows version later this year. Calcode Systems also plans to release a Windows version this year.

These products, with the possible exception of Derive, are tools for taking on large, complex projects that you want to tackle interactively—the kind of problems you don't expect to solve by fooling around for just an hour or two. What *kinds* of projects does this include? Computation of the homotopy groups of complicated topological surfaces, evaluation of multiparametric Feynman integrals in quantum field theory, and computation of fluid flow in complicated networks are just a few examples.

Mathematical software in general typically provides a set (or sets) of built-in mathematical functions, some ability to do calculus, and some equation-solving capabilities. What distinguishes symbolic programs from their numeric brethren is that the numeric programs manipulate data at the level of numerical calculation, while symbolic programs provide answers in terms of symbols. For example, given a single equation in two unknowns—x and y—a numerical program can't provide an answer, while a symbolic program will try to solve for x as a function of y, and will often succeed. (For a more complete and detailed definition of symbolic math, see the sidebar "What Is Symbolic Math, Anyway?")

Keeping track of symbols and high-precision real numbers requires considerable computing power, which slows down calculations. So if your needs are primarily for numerical calculation or data analysis, you may want to look elsewhere for a program that can handle such activities more efficiently. (For more information, see the sidebar "A Scientist's Software Toolbox.")

Mathematical software vendors have a fairly captive audience—one that would forgive a hostile user interface, provided the software produced mathematically correct results. Several of these products (Reduce, for example) have roots in the mainframe era and have been slow to enter the modern era of friendlier user interfaces. True, some degree of direct user input is always intrinsic to such software; for example, carrying on a direct dialogue with the system via a command line is often the most efficient way to enter information into the system.

More recently, users of math software have become spoiled by mainstream business software and less tolerant of complex, antiquated interfaces. Accordingly, mathematical software vendors now devote more attention to interface issues. When we first looked at Maple three years ago ("Statistical Software for the PC: Testing for Significance," *PC Magazine*, March 14, 1989), its interface was so poor that we declined to review the package until it had been improved. Thankfully, Maple V now has a slick, well-thought-out interface with on-line help,

links to an editor, and access to previous lines and program output. Reduce is still saddled with a user-hostile interface, but Calcode Systems plans to address the problem in upcoming versions. Derive has a menu-driven interface patterned after an early version of Microsoft Word, but the interface is dated and some thought needs to be given to adding mouse support, at the very least. Mathematica for Windows is the PC-based interface champion, with its lovely Notebook front end (see the Mathematica reviews for details). Good as it is, however, it falls short of the Notebook interface in Mathematica's Macintosh/NeXT implementation, which is our candidate for the ideal interface.

PC MAGAZINE

EDITORS' CHOICE

- **Maple V, Version 1.1**
- **Mathematica for Windows, Version 2.0**

If you've never seen this genre of software before, the capabilities of any of these programs will amaze you. But for breadth of features and user friendliness, two products stand out: Mathematica for Windows, Version 2.0, and Maple V, Version 1.1.

Mathematica for Windows has the most complete and flexible graphics and the largest array of functions. The Notebook interface, which combines elements of a word processor and an outliner, makes the Microsoft Windows version preferable to the DOS version, whose interface is a bit stark.

While applauding Mathematica for Windows' many strengths, we feel obliged to mention some areas where the product needs work. First, the program makes too many errors in simple problems. (Mathematica for Windows was notably worse in this respect than Derive or Maple V.) Second, the system requirements are high. Third, the Notebook interface is not yet fully implemented. And finally, the program has a copy-protection scheme that is not transparent.

The quality of Maple V's graphical output is on a par with Mathematica for Windows' output, and its kernel seems a little more comprehensive for elementary functionality. For a DOS program, Maple V's interface is excellent, although we are certainly looking forward to the Windows version, which is expected to make interactive documents like those of Mathematica for Windows' Notebooks possible. Still, the fact that Maple V and Mathematica for Windows came up with the wrong answer for our gravitational potential problem is a concern.

Derive gets an honorable mention for its solid kernel. It was the only program to answer the gravitational potential problem correctly and the only program to simplify nested radicals automatically. But its interface and graphics, which are virtually unchanged from two years ago, have been significantly surpassed by our Editors' Choice winners. Its minimum hardware requirements are no longer a significant advantage, and we are disturbed that the program doesn't make use of advanced hardware capabilities.

Reduce is not a competitive product, yet. Its base language is solid, but the package needs a more extensive library of functions—especially definite integrals, including those with infinite limits. Reduce has no graphics at all, and its user interface is awful. But with a bolstered kernel, plans to address graphics and interface issues, and an aggressive pricing scheme, Reduce could become a contender soon.

Because its focus is not symbolic, Mathcad was not formally reviewed here, but it has some simple symbolic capabilities and remains the product of choice if your mathematical needs do not require serious programming.

THINKING GRAPHICALLY

A picture is worth a thousand words, and that saying turns out to be as true for mathematics as it is in other realms. Graphics expressions of mathematical entities are now widely recognized as vital tools of mathematical exploration. Consequently, vendors of most symbolic math packages have built in at least some graphics capabilities.

The current version of Reduce is the exception; it has no graphics features. Derive and Maple V have considerable graphics abilities, although both packages are wanting in the areas of printing and exporting to industry-standard graphics file formats. Here also, Mathematica is king. Its graphics capabilities can be configured under programmatic control, so you can use color to convey information and not just to make the picture more attractive.

HOW WE TESTED THE SOFTWARE

Stephen Wolfram, who was the force behind Mathematica, once remarked that the only way to evaluate these packages accurately would be to conduct a two-year research project using each of them. Unfortunately, we did not have the necessary resources to carry out his recommendation.

To evaluate each package's richness and depth, as well as the accuracy of its symbolic algorithms, we compiled a test suite of 20 problems, several with multiple parts. Each vendor supplied solutions, optimized for its own product or products. The problems themselves are sufficiently technical that we do not attempt to explain them in detail here; some of the problems are listed in the sidebar "A Sampler of Symbolic Math Test Problems."

In the real world, especially for large projects, a package's programming language is likely to be the most important tool in the problem-solving arsenal; many problems simply require you to write programs in order to arrive at solutions. Fortunately, some problems can be solved interactively. Our test suite focused primarily on relatively simple problems that could be tackled in a short period of time, but it also included several medium-size projects that required 30 to 50 lines of code to solve.

PROBLEMATIC PROBLEMS

Two problems from our suite warrant special mention. Both problems were derived from a list of pitfalls—distributed by J. Kahane, a noted expert from the University of California at Berkeley—pertaining to mathematics executed on the computer. One mathamatical problem required the vendor to simplify the following expression:

```
Sqrt(4+2*Sqrt(3)) where Sqrt is the square root.
```

The answer is

```
1+Sqrt(3)
```

Those programs that claim to do algebraic simplification should be able to provide this solution. However, only Derive succeeded. Maple and Reduce could be coaxed into providing the correct answer if you configure them to solve a quadratic equation, but Derive's Simplify command worked properly here.

The other test problem concerned the calculation of the gravitational potential of a ball—a subtle integral—since the software must properly interpret the sign of a square root. Once again, only Derive

What Is Symbolic Math, Anyway?

Counting is second nature to computers, but there's more to mathematics than that. Most of the math done on computers, of course, *is* counting—simple, grade school-level arithmetic—but it is done very quickly. Algebra and calculus, however, require the ability to describe exact relationships between mathematical entities—a very different and much more difficult task.

$$\sum_{j=1}^{n} j^2 = \frac{n(n+1)(2n+1)}{6}$$

Beginning 30 years ago, several research groups realized that a combination of advances in computer hardware and programming algorithms made it possible to go beyond mere number crunching. Two pioneering groups became the standard-setters: the *Macsyma* project at MIT and the *Reduce* project led by Tony Hearn, a resident scholar at Rand Corp.

During the 1980s, several new academic researchers got into the game. A group centered at Waterloo University in Ontario wrote Maple; Dave Stoutemeyer at the University of Hawaii wrote MuMath, which was distributed by Microsoft Corp. in the mid-eighties, and Stephen Wolfram, then a postdoctoral candidate in theoretical physics at Caltech, wrote a program called SMP. Stoutemeyer later used his experience with MuMath to develop a revamped program called Derive; Wolfram founded a company to produce a new program called Mathematica.

THE SYMBOLIC SIDE

Computer algebra is the ability to do by algorithm what high school students are asked to do in the traditional way: factoring polynomials, solving equations for one set of unknowns in terms of others, multiplying matrixes where entries are functions rather than numbers, and so on. A sophisticated example would be a formula like the typical honors algebra exercise in the first box. Seeing a computer solve this kind of equation is thrilling; the solution to this sum calls for a highly sophisticated algorithm. The algorithms in the packages we review here, however, can also handle higher powers than 2 (indeed one of our sample problems involved the sum of 40th powers). The commercial packages are collections of multitudes of such algorithms plus algorithms for figuring out which algorithm to use.

Computer calculus is similar, although nonsymbolic programs can only compute definite integrals with numeric answers, and their calculations are approximate numeric answers. For example, numeric programs can only find the approximate answer to the equation in the second box. Symbolic programs will try to find a solution in terms of pi. They can also deal with indefinite integrals, which numeric programs cannot handle, since they express answers in terms of symbols, not numbers.

$$\int_{-\infty}^{\infty} \frac{1}{1+x^2}\,dx = \frac{\pi}{2}$$

In addition to their ability to handle algebra and calculus symbolically, these packages also perform numeric manipulations of a highly sophisticated kind. These operations are known as *exact rational arithmetic* and *arbitrary-precision real arithmetic*. Exact rational arithmetic allows the computer to deal with larger integers than the 9-digit numbers that standard number-crunching programs are limited to. Arbitrary real arithmetic lets you specify the exact degree of accuracy with which numbers are calculated and expressed, rather than being subject to the 10- to 15-decimal-place accuracy limits of ordinary double-precision computer arithmetic.

This kind of arithmetic is necessary, for example, if one wants to compute the integral in our second box exactly, or to solve quadratic equations exactly in terms of square roots. Another instance involves overcoming round-off errors.

An example used in evaluating math software is a special family of matrixes of rational numbers (exact fractions) called *Hilbert matrixes*. Numeric programs translate the rational numbers to real numbers, and they typically fail when the matrix size reaches about 12 by 12, because they get sabotaged by the round-off. One of our trial problems involved 30-by-30 matrixes. Symbolic programs work in exact rational numbers, so there is no rounding off. If the matrix gets too large, they may run out of memory. But unless there is a bug, their answers have to be correct.

All of these abilities make today's symbolic math programs a pleasure for those who regularly deal with mathematical objects.—*Barry Simon*

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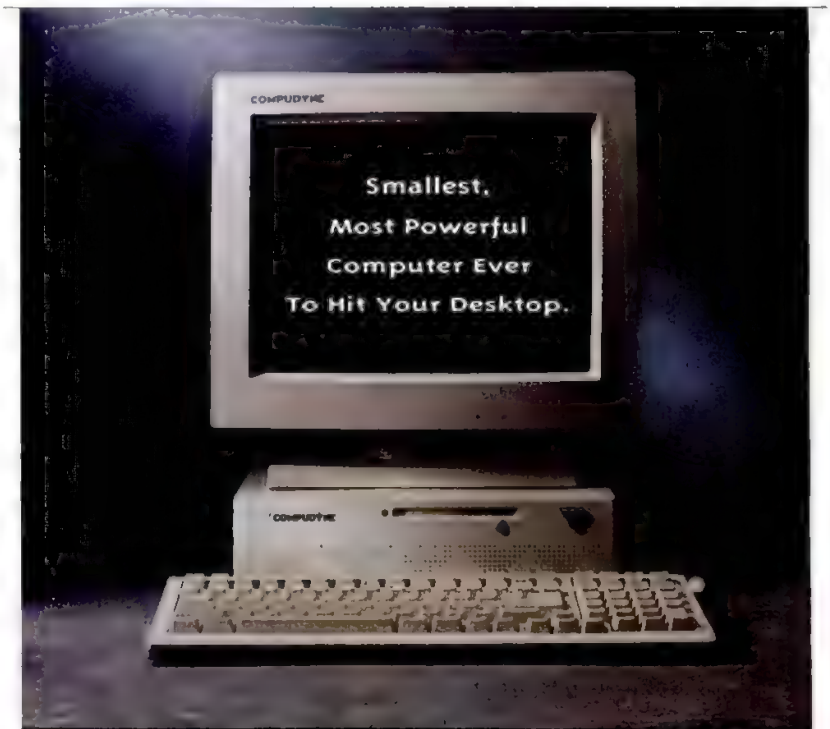

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gave the correct answer. Maple and Mathematica gave incorrect answers, and Reduce did not even attempt to automate definite integrals because, according to the math software vendor, its developers have not had the time to sort out all the algorithms needed to avoid pitfalls such as misinterpreting the sign of a square root.

If you've never used programs like these, you might be aghast at their potential to come up with wrong answers. After all, you'd probably throw away a spreadsheet that calculated a sum incorrectly. But automated symbolic mathematics is a minefield of potential problems, and these packages sidestep most of them admirably. While we hope for (and expect) improvements in accuracy as these math software packages continue to mature, they currently do an amazing job—most of the time. Meanwhile, you'd be wise to try to cross-check their solutions by attempting some special calculations for which you can get the right answer somewhere else.

ALSO OUT THERE

We chose not to review two other packages that have considerable symbolic capabilities. Symbolics' Macsyma hasn't had a significant upgrade in over two years, but the company hopes to release a significant upgrade later this year. The popular scratchpad Mathcad isn't designed primarily for symbolic manipulation and isn't really appropriate for handling large projects. We've chosen to discuss it in a sidebar (at right).

There is one final symbolic package on the horizon. The code for an extensive IBM research project called *Scratchpad* has been recently licensed to Numerical Algorithms Group (NAG), an England-based, long-time power in scientific programming. NAG has released an RS/6000 workstation version called *Axiom* and hopes to have a PC-based AIX version in the future. The recommended hardware components—32MB of RAM and 200MB of disk space—are awesome. But within a few years, that configuration may be fairly commonplace on a PC, and it's likely that *Axiom* will become a player in the PC symbolic math market as well.

As impressive as *Scratchpad* promises to be, it's not necessary to wait years to benefit from the desktop computer's ability to handle symbolic mathematics. Out

▪ Math Software for the Rest of Us: *MathSoft's Mathcad*

Mathcad, from MathSoft, has long been the leading product for engineers, physicists, and others wishing to do the kind of small- and medium-scale mathematical projects—computing an integral, inverting a numeric matrix, or solving a few nonlinear equations—that used to require a pencil, paper, and a calculator. Since it lacks significant built-in programming, Mathcad cannot be used for complicated mathematical analysis, but its terrifically intuitive interface and wide variety of numeric functions make it an ideal, intelligent mathematical scratchpad.

Until recently, Mathcad was unable to do any kind of symbolic manipulation. However, for its first Microsoft Windows edition—Mathcad, Version 3.0—MathSoft has licensed code from the makers of Maple, giving Mathcad limited but useful symbolic capabilities and bringing it somewhat closer to being an all-around math solution.

Mathcad's symbolic menu presents 14 functions, chosen to cover the most common symbolic operations: simplification and expansion, factoring, symbolic integration and differentiation, equation solving, series expansion (including partial fractions), and three matrix operations: transpose, inverse, and determinant. To put it into perspective, this enhancement constitutes only a small subset of the problem-solving prowess of the symbolic powerhouses, both in the scope of functions supported and in the depth of what those functions do. Maple itself, for example, has over a thousand built-in commands.

To expand on this, a good comparison would be between a parent and a child; Maple's linear algebra module features more than 100 functions, while Mathcad has only 3. Several symbolic routines are missing from Mathcad: eigenvalues and eigenvectors, null space, singular values, permanent values, rank values, and Jordan, Smith, and Hermite normal forms. Even where Mathcad does have a function, it's likely to be less extensive than its Maple counterpart. For example, Mathcad's Taylor expansion is limited to functions of a single variable, while Maple can handle multivariate functions.

Although we can't fault Mathcad for not being something it does not attempt to be, we do lament that the added symbolic functionality has not been integrated to take advantage of some of Mathcad's brightest features. For example, one of Mathcad's virtues is its mathematical hot links. If you change a value in Mathcad, the change automatically propagates through to all formulas involving that variable, just as on a spreadsheet. This feature doesn't work for symbolic expressions, however; these must be updated by hand.

Mathcad is by no means a replacement for Mathematica or Maple, nor is it likely to be soon. It would need programming and extensively expanded symbolic operations to qualify. But for the kind of quick calculations at which it has excelled in the past, it is now even stronger with the addition of the most significant symbolic operations.—*Barry Simon*

▶ FACT FILE

Mathcad, Version 3.0

MathSoft, 201 Broadway, Cambridge, MA 02139; 800-628-4223, 617-577-1017.

List Price: $495; upgrade from earlier version, $149.

Requires: 2MB RAM, Microsoft Windows 3.0 (Standard or Enhanced mode). Math coprocessor recommended

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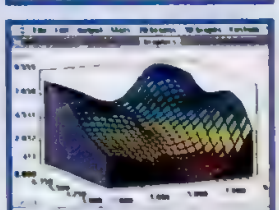

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A Sampler of Symbolic Math Test Problems

Here is a selection from the suite of 20 mathematical problems we used to test the symbolic math programs reviewed in this issue. The listing indicates the breadth of the categories we researched. The specific problems were forwarded to the software vendors, who then produced the solutions and returned them to us. Look for the results in the September 1992 issue of the *Notices of the American Mathematical Society.*

- Handling equations where round-off errors would stymie a nonsymbolic package.
- Simplifying symbolic expressions such as nested radicals, trigonometric sums, and a very accurate approximation to pi.
- Performing a complicated symbolic derivative, its indefinite integral, and a rather tricky multidimensional integral.
- Coping with limits, symbolic sums, polynomial factoring, factoring into primes and prime testing, one infinite sum, and two definite integrals.
- Performing a calculation in noncommutative algebra.
- Expanding and factoring polynomials.
- Solving simultaneous nonlinear equations in the complex domain.
- Finding symbolic solutions for two differential equations, and solving one recursion relation.
- Producing C and TeX versions of a function.
- Producing parametric, surface, contour, and polyhedral graphs; outputting them to a printer or an industry-standard file format.
- Drawing a fractal curve (Koch snowflake).
- Solving four mathematical problems requiring medium-size program fragments: computing the Feigenbaum constant, outputting a list of primes, solving a combinatorial problem, and manipulating Galois fields. — *Barry Simon*

of the five packages reviewed here, you should be able to find a package to expand your mathematical horizons.

Soft Warehouse Inc.

Derive: A Mathematical Assistant

ALL REVIEWS BY BARRY SIMON

Soft Warehouse's $250 Derive: A Mathematical Assistant, Version 2.1, is a technological marvel. Occupying just 240K of disk space, it often manages to accomplish what other programs need megabytes of code to do. Indeed, Derive's hardware requirements are the lowest of all of the packages reviewed here. It performs all but the most complicated problems quite well, works on a 640K XT-class machine, and does not require or make use of a math coprocessor. In fact, Derive's hardware demands are so minimal that it can run off a ROM card on the HP 95LX Palmtop PC.

Unfortunately, Derive is hampered by an inability to use advanced hardware, limited programming language capabilities (although the product does exhibit some remarkable prowess with the few language commands it has), and a somewhat dated user interface.

INTERFACE

Soft Warehouse apparently patterned Derive's interface after one that most Microsoft products used five years ago: a two-line menu at the bottom of the screen, which you move through with the Spacebar, Backspace, or Tab key rather than the cursor keys. Selecting options involves carefully wending your way through a series of spaces and tabs.

Since Derive's interface does not provide text wrap, long answers simply extend off the screen. This problem proves especially annoying when a medium-size matrix, such as a 6-by-6 matrix of rationals, is displayed as a single, long line. You can scroll horizontally to view the rest of an answer, but a wrapping option would be more convenient.

AT ITS HEART

Derive shines in a number of areas. It performs high-precision, real arithmetic using a clever set of rational approximations that may happily surprise you by getting more digits correct than you would expect. Its handling of tricky branch points is noteworthy as well. Derive's overall performance stood out on the simple, nongraphical portion of the test suite. Not only did it nail the gravitational potential integral, but it was the only package that could simplify a real radical. It did fail to find one complicated indefinite integral that was successfully evaluated by both Maple V and Reduce.

LIMITS

Derive's support for special functions falls short of the competition's. It has fewer mathematical routines (although the most important ones, Bessel, Error, and Statistical, are included), and support for all but the basic polynomial and trigonometry functions is deficient. For example, Bessel functions are defined as integrals via an external file. This is adequate for numeric evaluation, but the symbolic processor doesn't know about these functions, so if you ask for the derivative of a Bessel function, you get a sum of integrals instead of the expression in terms of Bessel functions of lower order.

Instead of using a full-fledged programming language, Derive lets you define functions. Two special functions—ITERATE and IF—give you something like programmability, especially since IF supports recursion. For example, you can define n factorial via F(n) := IF(n=1,1,n*F(n-1)). The included function libraries (and the solutions to our problems the vendor supplied) demonstrate that you can perform some remarkable tasks with Derive, but because it lacks the rudiments of a real language, Derive's programming remains inflexible and difficult to use.

Derive's on-screen graphics are good

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but not as visually spectacular as Maple V's or Mathematica's. Both do a better job with color and rules in surface plots than Derive. The program has no method for printing out graphs or saving them to a file. Instead, the vendor suggests you use DOS's Graphics command or a screen capture program. Alas, if you do so, your capture will include the Derive menus at the bottom of the screen.

TAPPED OUT?

While Derive doesn't make enormous hardware demands, it won't access the power of high-end hardware either. Nor will it use any EMS or XMS memory. I occasionally got "memory full" errors during the calculation of some complex problems. Although Derive was the fastest of the pack on most problems, it was painfully slow on those involving the factoring of large polynomials, possibly because of memory limitations.

SUITABILITY TO TASK

Derive: A Mathematical Assistant

	POOR	FAIR	GOOD	EXCELLENT
Interactive mathematics	●	●	●	○
Graphics	●	●	○	○
Programming	●	○	○	○
Integration/usability	●	●	○	○

Derive still has the features that earned it Editors' Choice status in our last roundup: speed on small problems, a user interface that stood out two years ago, especially strong symbolic routines, and the possibility of running on low-end hardware. But today, its interface seems klunky; it has not kept up with the hard-

▶ FACT FILE

Derive: A Mathematical Assistant, Version 2.1
Soft Warehouse Inc., 3660 Waialae Ave., #304, Honolulu, HI 96816; 808-734-5801.

List Price: $250; HP 95LX Palmtop PC ROM card, $289.
Requires: 512K RAM, 240K disk space (340K with all examples/libraries), DOS 2.1 or later.
In Short: Derive: A Mathematical Assistant stands out for its low hardware requirements and solid symbolics core. However, its minimal programming language makes it awkward for large projects. Its interface and resource usage are in need of an overhaul.

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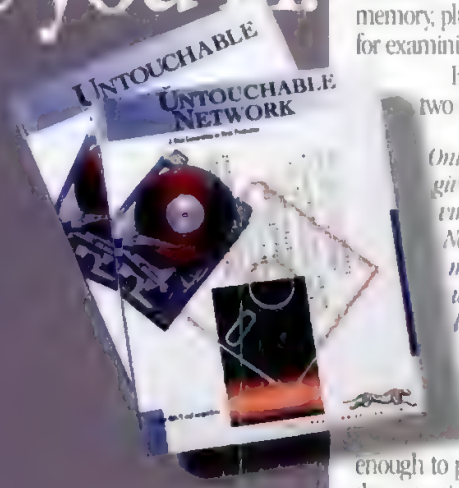

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A Scientist's Software Toolbox

Scientists have long been savvy computer users. Their involvement began long before the appearance of PCs, and they took naturally to the PC with its many specialized tools. While the symbolic powerhouses we review here get a lot of attention, technically oriented workers should know that there are a full range of math-related tools.

It is helpful to categorize programs into general groups so that choosing the right program for your needs is a matter of choosing the best from a category. Despite the tendency of some publications to lump packages like Mathcad, Gauss, and Mathematica together, they have about as much in common as Brief, Ami Pro, and PageMaker. There is some overlap of functionality, of course, but they are very different. Just as you wouldn't use PageMaker to write C code, you wouldn't use Mathcad to do a signal-processing problem that involves 70-by-70 matrixes. Scientific software tools are divided into three broad categories: theorists' tools, experimentalists' tools, and presentation tools.

THEORISTS' TOOLS

Among theorists' tools, the most sophisticated are the symbolic programs covered in this review. In addition to actual symbolic manipulation capabilities, they usually have some numeric capabilities and are the tools of choice for problems where round-off errors are a significant problem. But for many large numeric computations the best solution is a custom-made, compiled program. This way you can avoid the performance penalty that symbolic packages exact as they track exact rational numbers or high-precision decimals.

Of the scientists who write their own programs, many still use Fortran, but a language specially tuned to mathematics may be a better choice. The standard examples of such languages are Gauss (Aptech Systems, 23804 SE Kent-Kangley Rd., Maple Valley, WA; 206-432-7855; $495 to $995, depending on the version) and Matlab (The MathWorks, Cochituate Pl., 24 Prime Pkwy., Natick, MA 01760; 508-653-1415; $2,995).

In between Fortran and the specialized languages are general-purpose languages with a mathematical twist. Included in Symantec's Science and Engineering Edition of Zortech is DYAD Software's M++ Class Library. The APL language—in which STSC dominates the market—has always been a contender in this arena. STSC recently introduced Version 4 of APL*PLUS II/386, which will compile Microsoft Windows applications (STSC, 2115 E. Jefferson St., Rockville, MD 20852; 800-592-0050; $1,700; upgrade from Version 3.0, $495).

Symbolic programs and specialized number-crunchers are powerful, but that power is offset by a steep learning curve and requires some effort to harness. If you master one of these packages for large projects, you'll tend to stick with it when you do quick-and-dirty calculations, but if your only need is a mathematical scratchpad, then a powerhouse might be inappropriate. The leader here is Mathcad (MathSoft, 201 Broadway, Cambridge, MA 02139; 800-628-4223; $495). Its Windows version is a model of elegance and broad functionality. Just about any set of calculations you can fit on a page or two without programming or high-end symbolics is most easily done in Mathcad.

Also among theorists' tools are specialized equation/model solvers. Chief among them is TK Solver (Universal Technical Systems, 1220 Rock St., Rockford, IL 61101; 800-435-7887; $595). TK Solver is an old war-horse that has recently been upgraded. Number-crunchers and symbolic programs can solve equations, but the process is more streamlined in these specialized products. If your primary interest is in solving equations, you should also check out your spreadsheet, since the market leaders have added sophisticated solving routines in the past couple of years.

EXPERIMENTERS' TOOLS

If you are an experimental scientist, medical researcher, social scientist, or market researcher, you rely on data. The specialized number-crunchers can analyze data, and Mathematica has a large array of statistical functions, but data is not central to these packages' functioning. Programs with a data-centric focus are usually the best for analysis of experimental information.

There are some statistical dynamos topping the list of data analyzers. In our last roundup ("Statistical Software for the PC: Testing for Significance," March 14, 1989), the Editors' Choice winners were SPSS/PC+, Statgraphics, and Systat. These programs have batteries of statistical and canned graphical procedures you won't find elsewhere.

Another group of specialized tools for data analysis is model fitters. Often, theoretical considerations lead to models with free parameters, so you'll want to use this data to determine which parameters fit best. For models with linear relationships, the fitting is done with linear regression, which is found in many programs. For algebraic equations, you'll find fitting routines in many scientific graphing programs. But if the model equations are differential, you'll need a specialized fitter. Three such products for the PC are DiffEq (MicroMath Scientific Software, P.O. Box 21550, Salt Lake City, UT 84121; 800-942-6284; $395), MLAB (Civilized Software, 7735 Old Georgetown Rd., #410, Bethesda, MD 20814; 301-652-4714; $2,995; streamlined version, $995), and PCNonLin

(ClinTrials, 2365 Harrodsburg Rd., #A-290, Lexington, KY 40504; 606-224-2400; $370 to $595).

PRESENTERS' TOOLS

Graphical representation of data can provide insight into the significance of numbers and can be crucial in presenting data to others. We reviewed this software category last year ("Picturing Your Numbers: 12 Technical Graphics Packages," March 26, 1991) at which time the Editors' Choices were Axum (TriMetrix, 444 NE Ravenna Blvd., #210, Seattle, WA 98115; 800-548-5653; $495) and Graftool (3-D Visions, 2780 Skypark Dr., Torrance, CA 90505; 800-729-4723; $495). Since then, the makers of Graftool have released Stanford Graphics (First Looks, April 14, 1992), a powerful Microsoft Windows–based product.

Because of the special symbols used in equations, scientists have unusual typographical needs: There are specific symbols and objects such as complex fractions, matrixes, and doubly subscripted sequences that present tricky placement issues. While WordPerfect, Ami Pro, and Microsoft Word for Windows have the ability to create and manipulate equations, you must use a special window or mode to do so, and that can be awkward.

WYSIWYG scientific word processors have been around for several years. The leading DOS product is T3 (TCI Software Research, 1190 Foster Rd., Las Cruces, NM 88001; 800-874-2383; $595). The program that we used to type up a quick problem set is EXP: The Scientific Word Processor (Brooks/Cole Publishing, 511 Forest Lodge Rd., Pacific Grove, CA 93950; 408-373-0728; $295). If you want an equation add-on module for your DOS word processor, look at products from K-Talk Communications (30 W. First Ave, #100, Columbus, OH 43201; 614-294-3535). By the time you read this, the makers of T3 should have released a program called Scientific Word. It's a Windows-based product that's especially interesting because it uses TeX as its native file format.

Scientists frequently use Donald Knuth's TeX, which is a typographic markup language for text preparation. Many book publishers and technical journals accept TeX files directly. It's an attractive alternative because you avoid the need to proofread a typeset copy.

TeX files are prepared in an ASCII editor with cryptic commands like

```
$$\eqalign{X_1+\cdots+X_p&=m,\cr
Y_1+\cdots+Y_q&=n.\cr}$$
```

and then use a program to turn this source file into a .DVI (device-independent) binary file. With the right screen and printer drivers, you can display or print the .DVI file. Typically, you make a .DVI file, output it, fix errors, and make a new .DVI file.

If this sounds like programming with the typical edit/compile/debug cycle, it is. And too many young scientists seem to spend their time formatting their own papers instead of doing research, so Scientific Word is a welcome product. There are about a dozen PC implementations of TeX, including versions from Arbortext (535 W. William St., #300, Ann Arbor, MI 48103; 313-996-3566) and Personal TeX (12 Madrona Ave., Mill Valley, CA 94941; 415-388-8865).

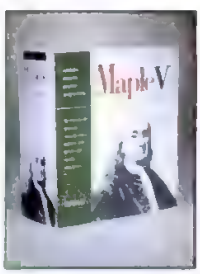
One final, specialized need of academics in general is for bibliographic software—specialized databases designed to allow for the differing style requirements involved in citing books versus journals, and the unique citation formats required by some journals. Three such programs are EndNote (Niles and Associates, 2000 Hearst St., Berkeley, CA 94709; 415-655-6666; EndNote, $149; EndNote Plus, $249), ProCite (Personal Bibliographic Software, P.O. Box 4250, Ann Arbor, MI 48106; 313-996-1580; $395), and Reference Manager (Research Information Systems, 2355 Camino Vida Roble, Carlsbad, CA 92009; 800-722-1227; $299 to $499).—*Barry Simon*

ware capabilities of current machines, and for simple problems, it now has substantial competition from Mathcad. It is still the math software product of choice for those on a budget and is sure to turn on bright high school students; the disappointment is how little Derive has grown in the last two years.

Waterloo Maple Software

Maple V

Maple V, Version 1.1, the $695 package from Waterloo Maple Software, is a serious contender in the contest to meet your mathematical needs. A solid package in all possible ways, Maple V has a vast library of mathematical functions, good graphics, an easy-to-use programming language, a well-designed user interface, and comprehensive documentation consisting of two lucid hardcover books.



Essentially an interactive command line with recall and edit, Maple V's user interface does possess a few features that hoist it above the MS-DOS C: prompt level. Hitting F10, for example, opens a menu through which you can call up 11 common procedures or up to 15 supplemental sets of mathematical routines. By keeping this library of routines separate from the core code, Maple V is able to minimize memory usage, incrementally increasing it as you select routines from the menu. Mathematica, by contrast, forces you to search for the routine names in its manual. You can also use the F10 menu section to change Maple V's submenu structure.

Maple V's linked editor can be accessed using either the menus or the screen-recall mode. The latter mode is

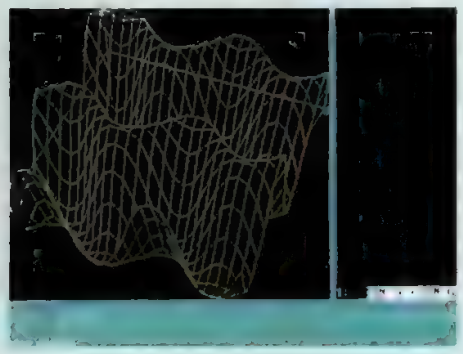
SUITABILITY TO TASK

Maple V

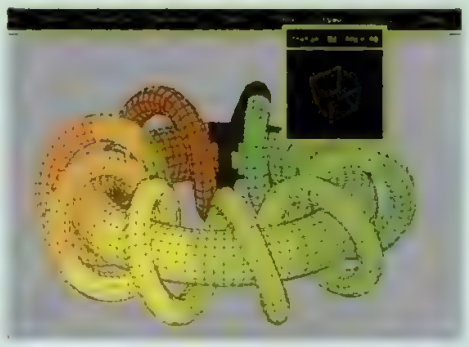
	POOR	FAIR	GOOD	EXCELLENT
Interactive mathematics	●	●	●	○
Graphics	●	●	●	○
Programming	●	●	●	○
Integration/usability	●	●	●	○

Graphics Tools Gain Importance in The World of Math

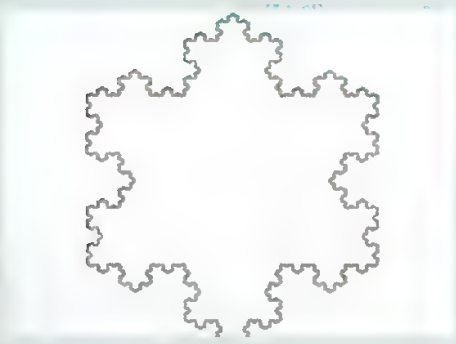
Graphical representations of mathematical constructs are gaining wide recognition as vital tools of mathematical exploration. Consequently, developers of most symbolic math packages have built in at least some graphics capabilities. Future versions promise to be even more graphics-oriented.



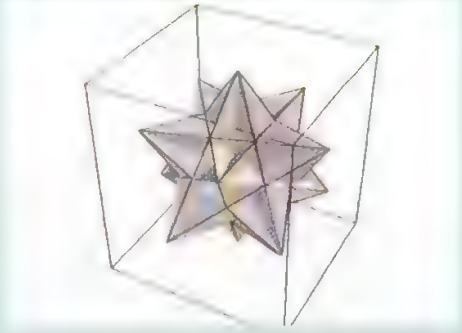
The graphics module found in Derive: A Mathematical Assistant features multiple windows and handles 3-D graphs



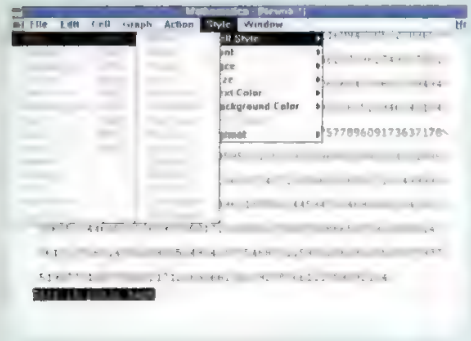
The graphics in Maple V can look spectacular From the 3-D graphics screen, you can call up a menu to set options.



The Koch snowflake, which is a famous fractal, was one of our test problems. Here is Mathematica for DOS's rendition



Mathematica for DOS has an outstanding ability to manipulate three-dimensional graphs of polyhedrons.



Mathematica for Windows' cell formatting offers a large number of built-in styles.

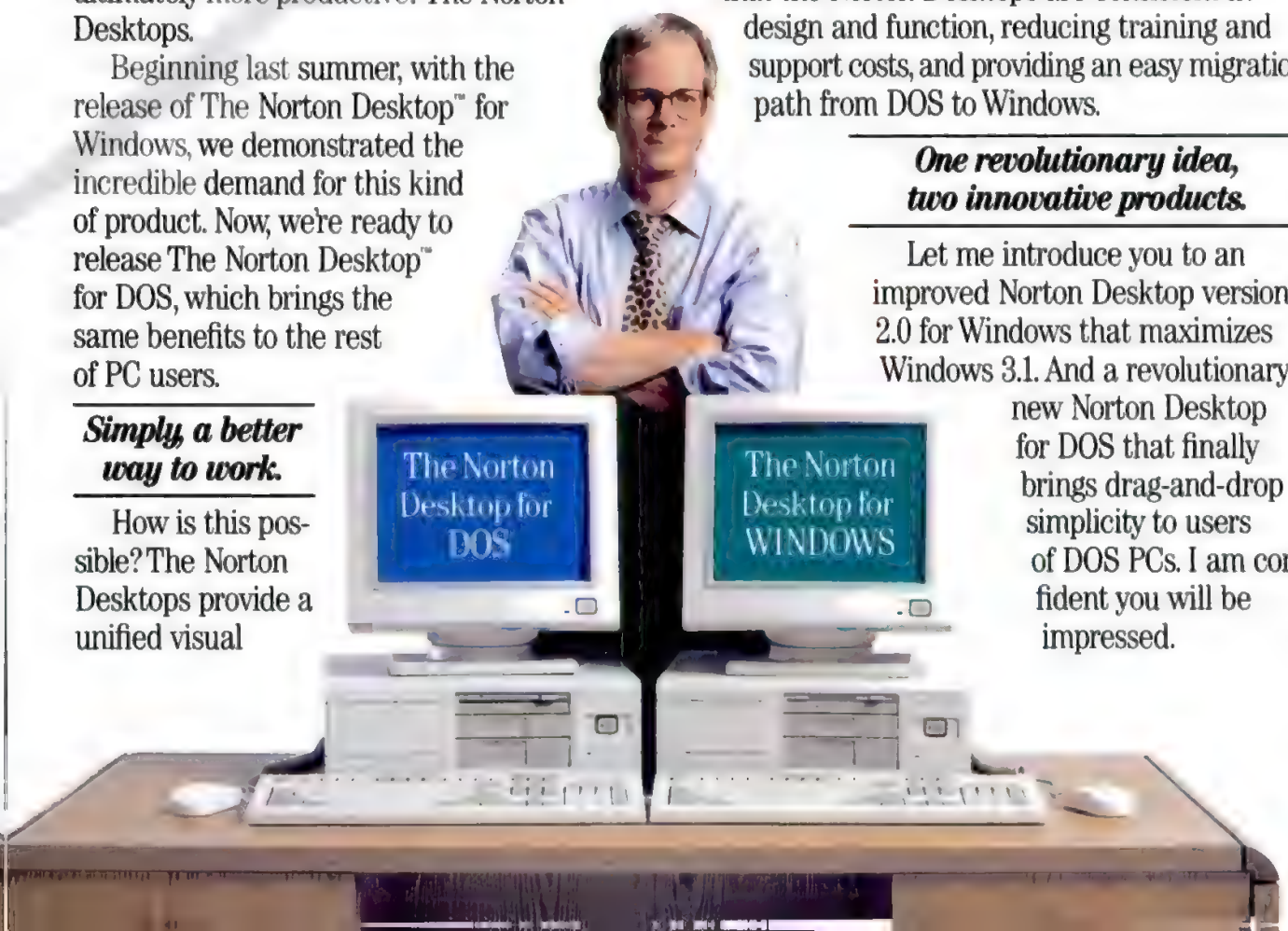
Reduce, Version 3.4, has a bare, command-line interface with considerable mathematical power.

Peter Norton On Desktops.

For many years, I have worked to help people gain mastery over their PCs by developing a number of powerful DOS enhancements and utilities. But these products were targeted to the more technically advanced user.

Now I am proud to announce a new category of products for every DOS and Windows user that makes computing easier, faster, safer, and ultimately more productive: The Norton Desktops.

Beginning last summer, with the release of The Norton Desktop™ for Windows, we demonstrated the incredible demand for this kind of product. Now, we're ready to release The Norton Desktop™ for DOS, which brings the same benefits to the rest of PC users.



Simply, a better way to work.

How is this possible? The Norton Desktops provide a unified visual approach—a desktop—that speeds and simplifies the way you work in DOS or Windows by granting easier access to the files, documents, and applications you use every day. While supplying a full array of non-technical tools that enhance the way you work and protect the results.

Corporate users will be interested to know that the Norton Desktops are consistent in design and function, reducing training and support costs, and providing an easy migration path from DOS to Windows.

One revolutionary idea, two innovative products.

Let me introduce you to an improved Norton Desktop version 2.0 for Windows that maximizes Windows 3.1. And a revolutionary new Norton Desktop for DOS that finally brings drag-and-drop simplicity to users of DOS PCs. I am confident you will be impressed.

The Norton

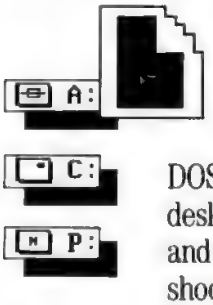
Point, Click, Drag, Drop. Now *This* Is DOS.

Norton Desktop For DOS

File Disk View Configure Tools Window Help

See how visually inviting and easy to use DOS can be.

Welcome to The Norton Desktop for DOS, a revolutionary new approach that gives DOS PC users visual drag-and-drop file management, in combination with a fully integrated set of easy-to-use utilities.



Drag-and-drop ease of use comes to DOS. To move files from your hard disk to a floppy drive just point and click.

Suddenly DOS takes flight.

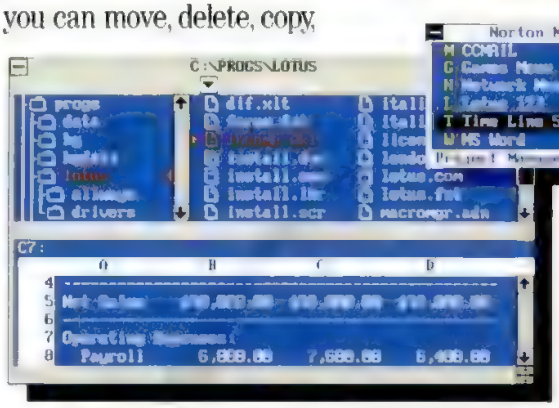
Imagine sitting down to your DOS PC and finding an intuitive visual desktop where you can manage files and run programs with point and shoot simplicity.

Suddenly, you can move, delete, copy, print, view, backup, or scan files for viruses, using the mouse to click, drag-and-drop. Or, use the keyboard.

And you can do all this with the security of Norton's acclaimed backup, virus protection, and data recovery utilities. You can even set up schedules to automate your backup and virus scans, so you'll never have to worry about losing data.

All, without using a single DOS command!

Plus, when you're in between work sessions, colorful, animated screen savers pop up over any application.



Double-click on a drive icon to see all your files in a movable, re-sizable window. Below it is a view pane showing a spreadsheet or any type of file you wish to preview.

Simply click on a file and drag it to our unique button bar to backup, print, or take other actions.

A new view of personal productivity

The Norton Menu automatically creates a menu of your applications. View files from any of over 60 popular applications as they would normally appear—without taking time to load the application. Even without having the application.

And because each function works the same way, once you've learned one feature, you'll be comfortable with the rest.

Corporate users should also know it supports all major networks.

A Window on the future.

Because its companion, The Norton Desktop for Windows, uses the same interface and commands, you'll have an easy migration path to Windows.

An investment with a guaranteed return.

The only way to truly appreciate The Norton Desktop for DOS is to see it yourself. The suggested retail price is only $179,* and it's backed with a 60-day money-back guarantee from the leader in quality utilities.

See your dealer now or call **1-800-343-4714 ext. 757** for information.† You will never see DOS the same way again.

1Help 2Menu 3NAV 4Backup 5Find 6Print 7Move 8Copy 9Delete 10PullDn

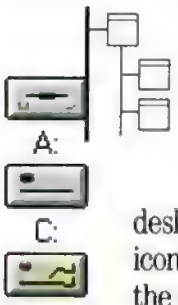
†Or call 1-800-554-4403 for an instant FAX Data Sheet (enter 755)

Desktops.

Make Fast Work Of Windows.

See what makes The Norton Desktop version 2.0 essential for Windows 3.1.

The Norton Desktop version 2.0 for Windows offers a new suite of features that fully optimizes Windows 3.1, making it easier to use, and helping you be more productive.

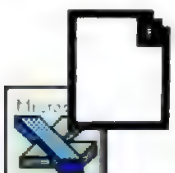


Watch Windows 3.1 sparkle.

Experience full drag-and-drop support across the entire desktop. Drag a file or drive icon to any desktop icon or onto the desktop itself—for instant access. Copy, move, delete, or print files by clicking and dragging them to buttons and icons.

Double-click on a drive icon to see all your files in a movable, re-sizable window. Below it is a view pane showing a spreadsheet or any type of file you wish to preview.

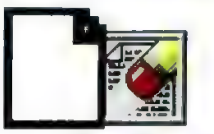
We've integrated the File Manager directly onto the desktop, to simplify file and program management. To access files, just click on a drive icon. You'll get over 45 file viewers that allow you to examine a file quickly and easily without pausing to load its application. And the customizable button bar puts often-used functions at your fingertips.



Frequently used applications and files can be placed on the desktop for convenience.

†Or call **1-800-554-4403** for an instant FAX Data Sheet (enter 750)

It all happens quickly, too. Version 2.0 loads up to six times faster than version 1.0 for even better performance.



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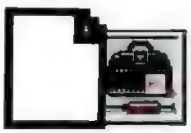
The Norton Desktop for Windows comes with a full set of utilities, including fast automatic backup; precision data recovery (with SmartErase™); comprehensive virus protection; and more.

You get all the utilities you need to backup, protect, and repair your data.



Because it works the same way as Windows, you'll see instant results. And it's compatible with all DOS and Windows applications, and leading networks.

To see it, make a fast trip to your dealer. It's only $179* (SRP), and it's backed with a 60-day money-back guarantee from the leader in quality utilities. Or call, **1-800-343-4714 ext. 779** to upgrade for just $49;** or ext. 755 for information.†

> *"I never run Windows without it."*
> Walter S. Mossberg
> *Wall Street Journal, 4/2/92*

Keep your favorite Windows applications and files in a customizable icon tool box.

SYMANTEC.

25 Reasons Why Every DOS or Windows User Needs a Norton Desktop.

The Norton Desktop for DOS.

Makes DOS Easier

1. Simple, intuitive drag-and-drop interface
2. Over 60 file viewers, so you can view file contents without launching the application
3. Powerful file management; allows you to find, view, backup, virus scan, copy, and more
4. Automatic Scheduler launches programs at any time
5. Pop-up reminders for meetings, phone calls, appointments, etc.
6. Full keyboard support for users without a mouse

Organizes Your Applications

7. Norton Menu loads applications with a keystroke
8. Autobuild™ feature automatically creates a menu of applications

Dependable Virus Protection

9. Protects against over 1,000 viruses—with FREE updates for protection against new viruses
10. Automatically protects in the background—using only 1K of memory (loads high)

Fast, Automatic Backup

11. Scheduler automatically performs unassisted backups
12. Backs up to floppies, hard disks, network servers, or tape drives
13. Advanced data verification to ensure reliability
14. Restores data even from damaged backup disks

Automatic Data Protection and Recovery

15. Automatically repairs most disk problems
16. SmartCan™ provides 100% recovery of deleted files even on a network

Portable Computing

17. Fast serial and parallel file transfer between your portable and desktop PC
18. Compares laptop and PC directories to keep contents current

Network Ready

19. Easily transfers files between computers on a network
20. Network installation available, with full support for Novell, LAN Manager, Banyan, LANTASTIC, and all NetBIOS-compatible networks

And More

21. Colorful screen savers with password protection
22. Disk cache boosts performance
23. Speed Disk™ optimizes hard drive performance
24. Transparent drag-and-drop file compression/decompression in ZIP format
25. Optional Norton Commander® mode

System Requirements

- —DOS 3.1 or higher
- —IBM PC, XT, AT, PS/2, or 100% compatibles
- —512K RAM
- —Hard drive required

The Norton Desktop for Windows.

Makes Windows Easier To Learn and Use

NEW 1. Global drag-and-drop across the entire desktop
2. Superior file management with single, integrated file and program manager
NEW 3. Loads up to six times faster than version 1.0
NEW 4. Graphical, expandable tree directory views by date, file type, size, or alphabetic order
NEW 5. Over 45 file viewers (including 19 new ones) let you view files without launching applications; permits searches from viewer
6. Animated color screen savers with optional password protection
NEW 7. View groups as icon toolbox or menu
NEW 8. Desktop arrange keeps your desktop organized
NEW 9. Customizable fonts
NEW 10. Enhanced Windows text editor (Desktop editor)

Fast, Automatic Backup

11. Schedule background or unattended backups
12. Fast—up to 5.6 MB per minute
13. Back up to network servers, Bernoulli boxes, or disk drives

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15. Restores re-formatted hard drives
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NEW ***Dependable Virus Protection***

17. Protects against over 1,000 viruses—with FREE updates for protection against new viruses
18. Automatically protects in the background—using only 1K of memory (loads high)

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19. Launch Manager starts a new program from one that's running. Access applications directly from Windows Control Menu
20. SuperFind searches drives and network servers for files by name, extension, attributes, date, and text strings
NEW 21. Batch Builder™ and Macro Builder™ help you build your own menus and automate tasks
22. Icon Editor and Librarian lets you use and customize a library of over 150 icons
23. KeyFinder™ instantly identifies keystrokes required for special text characters and symbols

Network Features

NEW 24. Network installation available, with full support for Novell, LAN Manager, Banyan, LANTASTIC, and all NetBIOS-compatible networks
25. Includes network security features like restricted file launching from drive windows

System Requirements

- —DOS 3.1 or higher
- —Windows 3.0 or higher
- —IBM AT, PS/2 or 100% compatibles
- —2 MB or more RAM (3 MB recommended)
- —9 MB free disk space (for full installation)
- —EGA,VGA, XGA, or SVGA video card

To see how The Norton Desktop for DOS or Windows can truly change the way you work with PCs forever, see your nearest retailer today.

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particularly useful when you've written a program that doesn't work. You can enter the screen-recall mode, mark off the program, call it into the editor, fix it, and reenter it into Maple V. While the package's help screen is not context-sensitive, it does share some of the interactivity of Maple V's other features. You can, for instance, open the help screen and capture examples—even whole programs—and enter them on the command line.

LIBRARIES

Maple V's code has two parts: a core or kernel written in C, which implements the Maple language primitives, and libraries of functions written in the Maple language. You interact mainly with the latter.

Maple V includes libraries for two- and three-dimensional geometry, projective geometry, differential forms, group theory, Boolean algebra, number theory, Gröbner bases, statistics, and linear algebra. Maple V, Version 2.0, expected out later this year, will add symbolic Fourier transforms, padic and Gaussian numbers, and algebraic function arithmetic. Together, Maple's kernel and standard libraries give you over 2,000 functions.

Maple V did well on our tests. Yet, like Mathematica, it didn't simplify the real radical, and it got the gravitational potential problem wrong. Maple V was able to do the remaining problems, although for several we had to resort to programming rather than relying on built-in functions.

Maple V has a good, Pascal-like programming language, and if you've done programming in C or Pascal, you are likely to find it easier to pick up than Mathematica's language. For developing complex programs in the Maple language, a syntax checker (Mint) much like C's Lint is provided.

ALSO NOTEWORTHY

Maple V's graphics, especially the tube plot, are eye-catching. Once a calculation is graphed, the F10 key brings up a menu that lets you adjust the palette, interactively change the viewpoint, and manipulate the graph. But Maple V's power to control this palette amounts to little more than window dressing compared with Mathematica's application of colors to convey mathematical information.

Maple V has a lot going for it now and may have more when Waterloo Maple finishes its Windows version.

The package supports a variety of printers, including HP LaserJets, several kinds of dot matrix printers, and PostScript. Maple V does not support bitmapped graphics files, but you can create vector-based HPGL and EPS files by printing to a file.

Maple V has a lot going for it now and may have more when Waterloo Maple finishes developing its first Windows version. It's expected to include integrated, live documents with upgradable formulas similar to Mathematica's Notebook front end. But for now, Maple V has the smoothest interface of the DOS-based products, a vast set of built-in functions, and a powerful programming language. These features are combined to yield an extremely attractive package that should meet almost anyone's mathematical software needs.

FACT FILE

Maple V, Version 1.1

Waterloo Maple Software,
160 Columbia St. West, Waterloo, Ontario, Canada N2L 3L3; 519-747-2373

List Price: $695.

Requires: 386-based PC or better with 2.5MB RAM, 7MB disk space, 80387 coprocessor.

In Short: Maple V gives you a solid combination of mathematical and graphical power, while maintaining a pleasant user interface.

ON READER SERVICE CARD

Wolfram Research Inc.

Mathematica for DOS
Mathematica for Windows

Some software publishers with their eyes on the future are beginning to talk about cross-platform core code for future products, but that vision has long been a reality at Wolfram Research Inc. (WRI). Its $895 Mathematica for DOS, Version 2.0, and $995 Mathematica for Windows, Version 2.0, share core code not only with each other, but with Mathematica versions for Cray, NeXT, Sun, and Macintosh computers.

Each version of Mathematica consists of two elements: the common core (or kernel) and a platform-specific user interface. The DOS version's front end is a plain-Jane teletypewriter interface (no control-key sequences, just characters) with an editable command line. Mathematica for Windows features the same Notebook front-end graphical user interface that has long been available for the Macintosh and NeXT versions. Wolfram Research calls these interfaces Notebooks because the resulting files are documents mixing text and formulas, much like a scientist's notebook.

Core functionality is common across both environments, so what we have to say about it, and the package as a whole, applies to both versions. On the other hand, the two Mathematica versions offer very different user interfaces. For that reason, they are discussed separately.

THE KERNEL

With Mathematica, Wolfram has set some extremely ambitious goals. Mathematica aims at being a complete tool for the exploration of mathematical ideas and objects. For example, graphics has always been a key part of the product. In fact, Mathematica's strength in this area has driven many of its competitors to enhance their own graphics capabilities. Version 2.0 introduces sound capabilities—enabled via a Sound command—to add the ear as a resource for understanding mathematics. Both Mathematica for DOS and Mathematica for Windows support the built-in speaker and Creative Labs' Sound Blaster board. Unfortunately, I was unable to get the program to recognize the Sound Blaster on my system.

THE LANGUAGE

Wolfram's ambitions also extend to Mathematica's programming language,

which it hopes will replace Fortran and C as the programming lingua franca of science. Accordingly, the language includes some low-level hooks like access to the size and date of files.

Mathematica's language uses case-sensitive keywords and square brackets for arguments. So, if you type Factor-integer(124) rather than Factorinteger[124], the program thinks you are trying to define a new variable called Factorinteger and multiply it by 124. This is different from standard mathematical notation, which uses "(" and ")" both for functions, as in f(x), and to separate expressions, as in (x+1)(x-1). To avoid ambiguity, Mathematica uses f[x] rather than f(x). While this sounds admirable, even experienced users tend to write (..) when they should be using [..].

A couple of special features make this case-sensitive command language a little more palatable. Both versions of the program let you type a few letters, hit a key or two (Tab in DOS, Alt-K in Windows), and access a list of all commands that start with the characters you've entered. You can then select the full command from this list. The program also has a built-in spell-checker so if you mistype a command, you'll get a message suggesting that you might have intended a different spelling.

Mathematica aims at being a complete tool for the exploration of mathematical ideas and objects. For example, graphics have always been a key part of the product.

In sum, Mathematica's language is powerful and succinct, though not as close to C or Pascal as Maple V's. The number of mathematical routines included with Mathematica is astounding. The core language, as described in Wolfram's book *Mathematica: A System for Doing Mathematics by Computer* (published by Addison-Wesley and available separately or as the user's manual that ships with Mathematica), contains nearly 850 different commands. There's also a supplemental set of 143 files that includes additional commands, 19 graphics packages, and seven collections of statistical routines.

VISUALS

Mathematica's PostScript graphics make it one of the most visually impressive of all the symbolic math programs (although Maple V is a close second). In addition, graphics objects are accessible through the programming language, so you can use color to convey mathematical information. For example, colors can also have an "IF" significance: "Color this part of the graph red if the value is less than 0 and black if greater than or equal to 0."

They're turning over in their graves!

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Printing your Windows pages from an HP LaserJet® can be a ghoulish experience—slow, cumbersome, inflexible. That's because your HP was designed to print from DOS, not Windows™. Oh, sure, you could add cartridges and more memory to your printer, but that's a dead-end solution.

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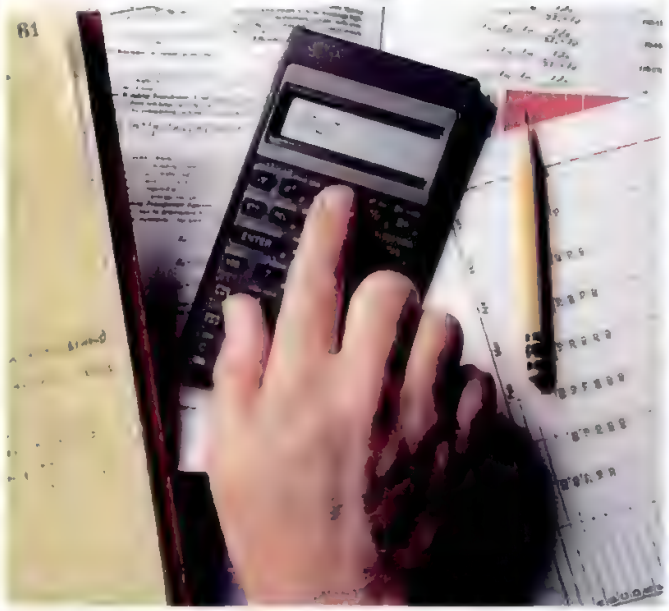
CIRCLE 195 ON READER SERVICE CARD

There are two ways to do your math.

Drag.



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Done calculating? Mathcad prints out presentation-quality documents complete with equations in real math notation.

PC MAGAZINE THE BEST OF 1991 COVER STORY

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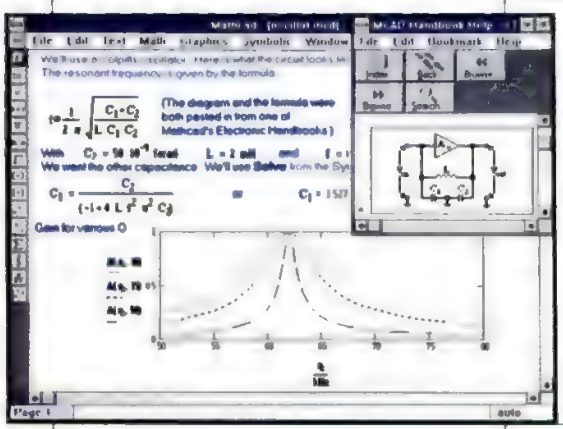
And now there are three new optional Electronic Handbooks,* created with the leading publishers of technical handbooks: The CRC Materials Science and Engineering Handbook, Machine Design and Analysis from McGraw-Hill, and the Mathcad Treasury of Methods and Formulas. Plus optional Applications Packs with modifiable templates for all major engineering and science fields.



PC MAGAZINE EDITORS' CHOICE

Mathcad 2.5
3-14-89 issue.
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Best of '87

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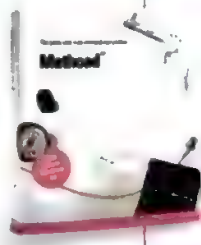

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CIRCLE 154 ON READER SERVICE CARD

SUITABILITY TO TASK

Mathematica for DOS

	POOR	FAIR	GOOD	EXCELLENT
Interactive mathematics	●	●	●	○
Graphics	●	●	●	●
Programming	●	●	●	○
Integration/usability	●	●	○	○

Mathematica will even animate a series of graphics so you can see a dynamical system evolve. Finally, Mathematica has a powerful set of built-in graphical primitives such as polyhedrons, polytopes, splines, and spirals.

THE DOWNSIDE

Mathematica's basic kernel has improved in numerous ways since Version 1.*x*. Symbolic sum and recursion relation problems that Mathematica, Version 1.1, failed to handle on our test suite last time are now adroitly calculated by Version 2.0. Yet despite its ambitious features, Mathematica suffers from a somewhat flawed implementation. The kernel lacks mathematical capabilities in some important areas, and Mathematica requires substantial hardware resources to achieve adequate performance. Moreover, the PC versions incorporate a copy-protection scheme that is anything but transparent. Not only did it fail to recognize passwords with QEMM loaded, but in order to access Mathematica easily, we eventually had to reboot and run it without the memory management software.

While Mathematica produced impressive results on the graphical part of our test suite and did well on medium-size problems that required some programming, its performance on problems intended to test the basic capabilities of its kernel was disappointing. The 11 problems in this category called for 25 separate calculations. Mathematica got one wrong and failed to provide an answer for three others. (By comparison, Derive was unable to provide one answer and required custom code for two others; Maple V got one answer incorrect and needed custom code for three others; and Reduce required custom code for eight problems.)

While much of the custom code that Derive and Maple V needed was for handling the relatively esoteric area of Gaussian integers, Mathematica's failings were of a more fundamental nature. Its performance was especially poor, for instance, in integration-related issues. Mathematica failed to calculate an integral that Maple V and Reduce handled easily. It was also unable to solve an ordinary differential equation handled by all the other programs. While the competitive packages' inability to handle Gaussian integers is by no means trivial, Mathematica's problems are more fundamental: Virtually everyone who buys a symbolic package will need to use its integration routines; a very small fraction of users will even need to use Gaussian integers. Interestingly, Mathematica does feature built-in routines for the latter. On the other hand, Mathematica is the youngest of the math products reviewed here, and as it matures, these gaps are likely to be filled in.

DOS INTERFACE

Compared with Maple V (and Mathematica's own Windows version), Mathematica's DOS interface is a bit on the clunky side. Much like the DOSKEY feature in MS-DOS 5.0, it lets you toggle through previous commands and edit them. The F2 key is a shortcut for command completion: Type a few characters of a command, hit F2, and a list of possible endings appears from which you can select a complete command.

Manipulating formulas, calculations, and graphics in Mathematica for DOS can be a sticky operation. Unlike the Windows version, it has no pull-down menus; it does not provide a simple way to generate the necessary though sometimes arcane commands needed to set the options involved. You can query the kernel for help about a particular command, but there is no general on-line help except for one screen that defines some of the keystrokes. Furthermore, once you've entered commands designed to alter the view or appearance of a graphics image, the changes can be displayed only by shifting from text to graphics mode.

Compared with Maple V (as well as Mathematica's own Windows version), Mathematica's DOS interface is a bit on the clunky side.

Officially, Mathematica for DOS requires 16MB of disk space for a swap file and 4MB of RAM. You'll find performance marginal with that minimum configuration. We recommend no less than 6MB to 8MB of RAM.

FACT FILE

Mathematica for DOS, Version 2.0

Wolfram Research Inc., 100 Trade Center Dr., Champaign, IL 61820; 800-441-6284, 217-398-0700

List Price: Standard version (for use without coprocessor), $595; enhanced version (for use with coprocessor), $895.

Requires: 486-based PC, 3.5MB RAM (6MB to 8MB recommended), 7MB disk space for program files, 16MB disk space for swap files, 80386/80387 coprocessor (for enhanced version), DOS 3.0 or later.

In Short: Mathematica for DOS incorporates a grand conception with strong graphics and a programming language, but there are some gaps in the basic algorithms. The user interface is not as easy to use or as flexible as the Microsoft Windows version. Copy-protected.

158 ON READER SERVICE CARD

WINDOWS INTERFACE

Thanks to its Notebook front end, Mathematica for Windows far outdistances its DOS brother in ease of use. Along with the requisite pull-down menus, it features on-line help (although it addresses only the front end and not the kernel) and many text-handling abilities typically found in word processors and outliners. Mathematica for Windows also displays graphics along with text, and there is a visually interactive viewpoint changer for 3-D graphics. It also supports the Windows-based .BMP and .WMF formats, but not .PCX, TIFF, or CGM.

ELEMENTS

The intention of the Notebook front end, as the name implies, is that it should be a tool for the distribution of technical docu-

ments or *notebooks* of technical information. Indeed, some authors have even written books using Mathematica on the Mac and NeXT platforms.

The fundamental unit of a notebook-based document is a *cell* in which you can place text, formulas, or graphics. Cells can use the full array of Windows fonts, and they can employ a wide range of styles, which are defined in a master stylesheet. Cells can also be grouped to behave like the elements of an outline that you can collapse and expand.

Alas, Mathematica for Windows is missing several elements of the complete Notebook interface, but Wolfram promises they will be included in Version 2.1. Currently, each paragraph can use only one font and one style at a time, and DDE support is missing. Graph and Action menus provide additional flexibility. The Graph menu includes commands that change the way graphs are displayed (for example, Show Filled Area), commands to convert a graph to a metafile or bitmap, and commands to animate a series of graphs or align them. The Action menu includes commands to call up the interactive 3-D viewpoint selector, to invoke a color changer, and to clear the command history.

In general, Mathematica has some gaps, but it also has more of a vision of where symbolic programs should be.

UP AHEAD

Wolfram has ambitious plans for links to other programs. Mathematica for Windows, Version 2.0, was supposed to have a feature called MathLink to allow communications between Mathematica and other programs, but it has been postponed until Version 2.2.

Mathematica for Windows has even more extensive hardware requirements than its DOS-based counterpart. It runs only in 386 Enhanced mode, and you'll really need 8MB of RAM and a math coprocessor for adequate performance. Yet even though the DOS version has virtually the same kernel as the Windows version and lower hardware requirements, you'll probably prefer to work with the Windows version because of its superior user interface, which includes both graphics (interactive viewpoint) and text handling (notebooks).

In general, Mathematica has some gaps, but it also has more of a vision of

SUITABILITY TO TASK

Mathematica for Windows

	POOR	FAIR	GOOD	EXCELLENT
Interactive mathematics	●	●	●	○
Graphics	●	●	●	●
Programming	●	●	●	○
Integration/usability	●	●	●	●

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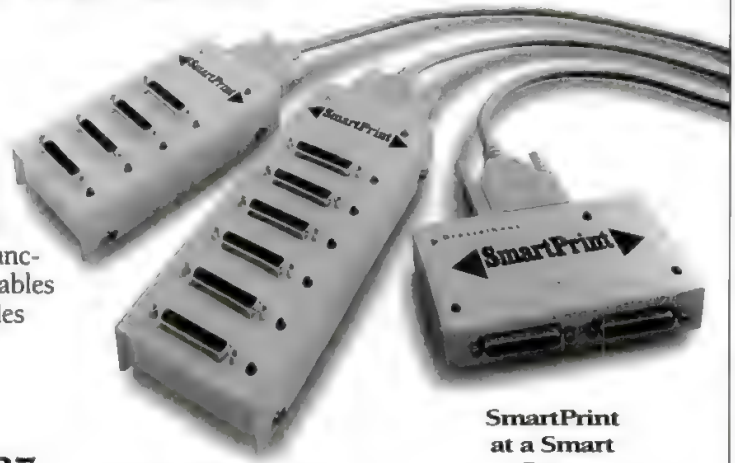

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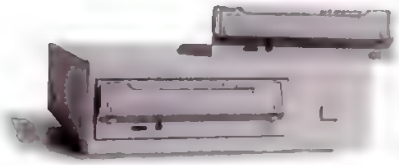

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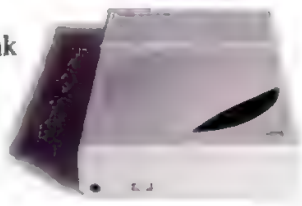

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FACT FILE

EDITORS' CHOICE

Mathematica for Windows, Version 2.0

Wolfram Research Inc., 100 Trade Center Dr., Champaign, IL 61820; 800-441-6284, 217-398-0700

List Price: $995; upgrade from Mathematica for DOS, Version 2.0, enhanced version, $125

Requires: 486-based PC, 4MB RAM (8MB recommended), 7MB disk space for program files, 16MB disk space for swap files, 80386/80387 coprocessor, DOS 3.0 or later, Microsoft Windows 3.0 or later

In Short: In Mathematica for Windows, you will find the same grand conception and programming language as in the DOS version, along with the same gaps in the basic algorithms. The Notebook interface and enhanced graphics support make this version preferable to its DOS sibling. Copy-protected

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where symbolic math programs should be. The Microsoft Windows Notebook interface adds ease of use to an area of software riddled with complexity. This is one great idea that other math software vendors would do well to emulate. And Wolfram Research's Mathematica for Windows also garners an A+ for recognizing the power and importance of graphics in symbolic mathematical representation.

Calcode Systems

Reduce

Reduce, Version 3.4, from Calcode Systems, began its life on the mainframe, and is considered one of the grandfathers of the symbolic mathematical universe. Today, it has spawned a number of versions for Unix and VAX systems, and more recently, a $495 PC-based version.

On the PC, Reduce features considerable though uneven power, and it retains much of the mainframe flavor of its origins. Its primary strength lies in an elegant and powerful programming language, but the package lacks many elementary math functions, such as simplifying radicals and definite integrals, and the main program is wrapped in what can only be called a user-hostile interface.

DOS-LIKE

When you load Reduce, it acts very much like MS-DOS, mimicking the operating system's spare command line interface. Reduce's only edit keys are a destructive Backspace and F3 to recover one previous command, and the method Reduce uses to bring an earlier command line into an editor makes Edlin look good. You can't even manipulate a command with cursor keys. In this default command-line editing mode, whatever information scrolls off the screen is lost.

There is, however, a second mode called *paged mode*. You access it by typing ON PAGE at the command line and exit it with OFF PAGE. In this mode, you can save output to a file and scroll back to see output that goes off the screen, but there is a price. In paged mode, if output extends beyond the screen, Reduce stops after each full screen and presents a "More" prompt before continuing onto the next one.

Reduce offers no on-line help, and the manuals lack a clear alphabetic command list. The program does not support graphics. However, a Microsoft Windows version is under development, and should address both the user interface and graphics issues. While its hardware requirements resemble some of the other products that are reviewed here (Reduce requires a 386 machine and a minimum of 2.5MB of RAM, but 4MB is recommended), it doesn't require a math coprocessor.

POWER—IF YOU CAN TAME IT

Reduce provides two programming languages: a powerful, Pascal-like language and a lower-level language that is a variant of LISP and the language in which Reduce was written. The first language is so powerful that for our test problem involving a linear recursion relation, the vendor supplied a 26-line routine that could solve *any* linear recursion relation. The pattern-matching portion of the language is good enough that the solution of the problem of finding the formula for tan(x+y) merely required writing the formulas for sin(x+y) and cos(x+y) and defining tan in terms of sin and cos.

While powerful, Reduce's programming language is difficult to use. For example, rather than just issuing a command to factor integers, you must first turn on factoring with a command that reads "ifactor on" and later turn it off. If you don't turn it off, the next time you ask Reduce to factor a polynomial, it factors the coefficients as well.

Reduce's built-in routines for solving ordinary differential equations are flexible, but those for solving nonlinear functional equations are not.

While Reduce's built-in routines for solving ordinary differential equations are flexible, those for solving nonlinear functional equations are not. There's nothing resembling the rich array of special functions found in competing programs, and in particular, there are no Bessel functions.

OTHER ROUTINES

The basic executable file is about 1.2MB, but the package includes optional libraries of mathematical routines. Additional libraries are available via electronic mail from Rand Corp., the company that currently employs Tony Hearn, Reduce's creator. Despite the amount of code, many basic mathematical functions are missing. For example, there are no primi-

FACT FILE

Reduce, Version 3.4

Calcode Systems, 1057 Amoroso Pl., Venice, CA 90291; 310-399-7612

List Price: $495

Requires: 386-based PC or better, 2.5MB RAM (4MB recommended), 3MB disk space (10MB disk space for all libraries and source code), DOS 3.0 or later

In Short: Reduce's solid language is marred by the absence of graphics, libraries that fail to cover many basic areas, and a poor user interface.

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What does Reduce bring to the mathematical table? Not much— as compared with other products reviewed here.

tives for computing definite integrals—something every other package reviewed here has—and most limits can only be done if you use L'Hospital's rule by hand.

Among the specialized routines provided with the program are sets to deal with differential forms, algebraic number fields, and Gröbner bases. It's an eclectic collection, however, determined more by what the package's third-party researchers have written over the years than by any intention to provide expansive, balanced functionality.

The current answer to the question "What does Reduce bring to the mathematical table?" must be "Not much"—as compared with other products reviewed here. Be that as it may, programming languages are subjective, and they often take a long time to learn. So if you've already invested time in learning Reduce, there may not be a compelling reason to switch, especially since a Windows version is in the offing. And since it has a solid language at its heart, Reduce could become a serious competitor if Calcode Systems addresses the problems of its limited function libraries, its interface, and its lack of graphics. □

SUITABILITY TO TASK

Reduce

	POOR	FAIR	GOOD	EXCELLENT
Interactive mathematics	●	●	○	○
Graphics	N/A			
Programming	●	●	●	○
Integration/usability	●	○	○	○

BARRY SIMON IS A PROFESSOR AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY AND A CONTRIBUTING EDITOR TO *PC MAGAZINE*.

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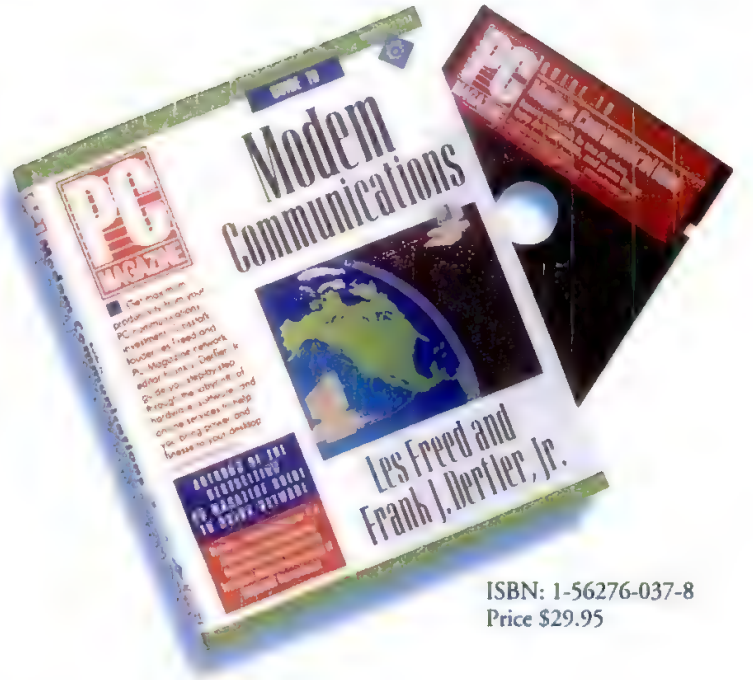

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2-D ANIMATION SOFTWARE

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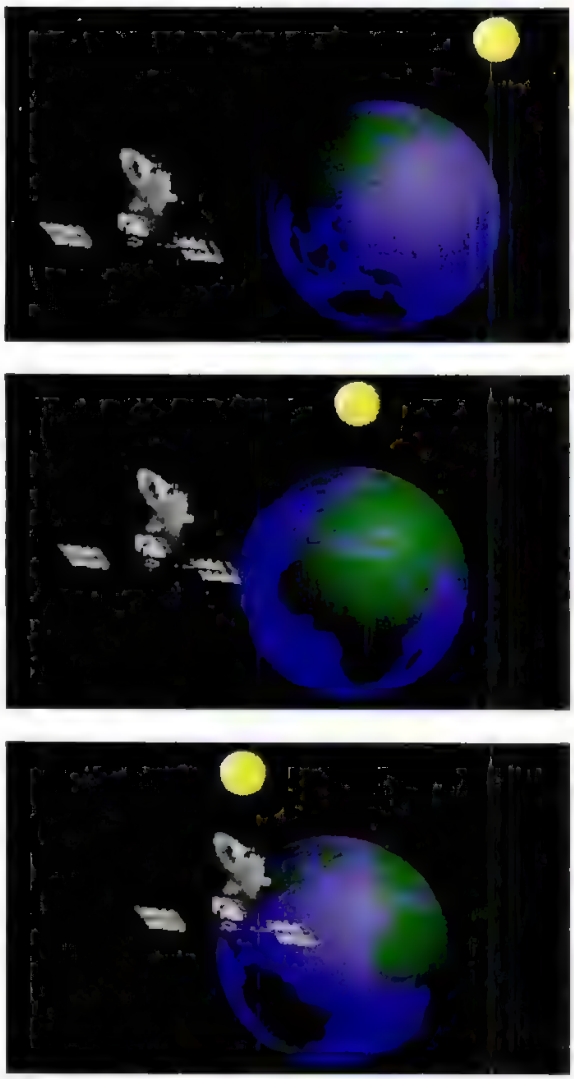

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That message has not been lost on corporate America, where animation is becoming an increasingly important and powerful communications medium. These programs, which give professional artists and business users alike unprecedented access to sophisticated two-dimensional animation techniques

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by Luisa Simone

can mean big business for your business.

Unlike photography, conventional movies, or live-action video—which require you to point a camera at something real—animation gives an audience a window into your mind's eye. You can show a client how a new widget works before you've built the prototype. You can take invisible events, like subatomic collisions, and make them visible. You can even model complex processes so that the flow of information or the evolution of a concept can be understood immediately.

The best animation adds meaningful movement to your presentations. Yet it would be foolish to ignore the razzle-dazzle factor: In a world where you must often compete for a client's attention before you can compete for his business, flying logos, special effects, and MTV-inspired graphics are useful attention-grabbing devices.

We selected six products for inclusion in this review—Action!(Macromedia), Animation Works Interactive (Gold Disk), Autodesk Animator Pro and Autodesk MultiMedia Explorer (Autodesk), Deluxe Paint Animation (Electronic Arts), and PC Animate Plus (Presidio Software). Each allows you to draw complex paths directly on-screen and to work interactively with elements. Some low-cost programs, including The Animation Studio from The Walt Disney Software Co., were omitted from this review because they concentrate on the tracing or onion-skin technique to the exclusion of all other methods. We also required that the programs cost less than $1,000; in fact, they range in price from a low of $134.95 to a high of $795.

There have always been a broad range of animation programs on the market, but they weren't very interactive. DOS-based screen-show programs such as Brightbill-Roberts & Co.'s Show Partner F/X and IBM's Storyboard Live! have been the mainstay of business animations for years. These programs can move animated elements, called *sprites*, across the screen. In contrast with the programs we reviewed, which use drop-down menus and dialog boxes to accomplish their magic, Show Partner and Storyboard require that you create transitions and movements by entering commands into a script.

In the same way, many established PC-based animation products are command-driven or require programming skills. P11, from The Animated Software Company, is popular among educators but uses statements like \DRAW P2,D,C2R33M to paint a line. GRASP (Graphic Animation System for Professionals), from Paul Mace Software, is often the engine that drives trade-show demos. But GRASP is an interpreted programming language, and so it has remained a tool for professional artists rather than business users.

Programs such as GRASP and Storyboard Live! have defined market niches and earned a loyal following. For example, professionals appreciate GRASP because animations can be distributed as a single executable file—an important feature for self-running demos. AT&T Graphics Software Labs' $3,290 Rio Animator defines the high end of the PC-based 2-D animation market. Rio Animator is a menu-driven, object-oriented program that outputs full-color, broadcast-quality animations directly to tape—something the less expensive packages don't do as well, if they do it at all.

Increasingly, other product categories, like presentation graphics and screen shows, are adding animation-like features. Presentation programs such as Aldus Persuasion and Claris Hollywood can create automatic builds, in which each line of a text slide is added sequentially. Standalone screen shows, such as Eclipse Technologies' Madison Ave., concentrate on importing images and adding transition effects and sound. Panorama, AT&T Graphics Software Labs' professional-level screen-show product, handles full-color, broadcast-quality video images.

Suitability to Task: 2-D Animation Software

To test each product, we created four different animation sequences specifically designed to simulate typical business animations as well as more creative art films. The common link was a fictitious company called Pulsar Communications specializing in satellite transmissions.

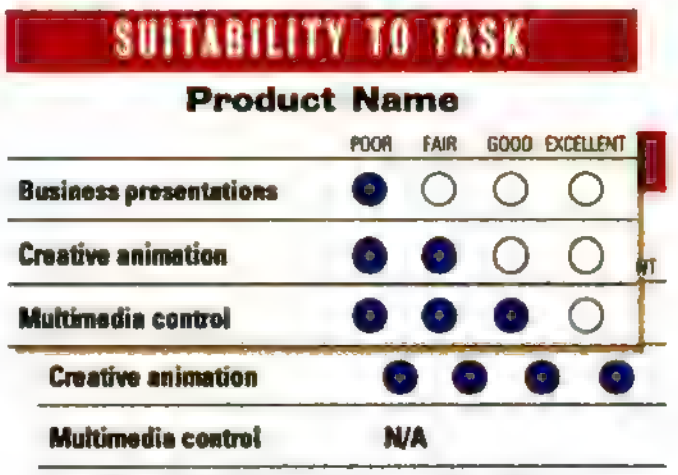
The company logo in the opening segment stressed the program's text-handling capabilities.

This was followed by a depiction of satellite dishes and packet transmissions that required the program to import or convert bitmapped pictures in a standard file format (.PCX), as well as to use color cycling for the motion effect.

In the third animation sequence, elliptical orbits for both the moon and a satellite around a rotating globe provided a unique opportunity to draw irregular paths, define the center of rotation, and work with hierarchical linking functions.

A fourth scene, depicting sunspot activity, was designed to exercise the program's painting functions.

Finally, all of the individual segments were linked together for playback. Playback loops, Goto commands, and sound files were all added at this stage of development.



N/A—Not applicable: The product does not perform this task.

Since most **business presentations** are created on tight deadlines, the ability to generate animations quickly and easily is a top priority, as is the ability to play back those animations in a variety of environments. Because presentations tend to be text-intensive, high-quality fonts are also important. The ability to pause, stop, or branch to another part of the presentation is a plus.

A flexible **creative animation** package has sophisticated paint and image-acquisition tools, as well as advanced morphing, looping, and in-betweening techniques. Palette optimization functions, including the ability to create a single palette for several images, are a must for negotiating among imported bitmaps.

If a package has good **multimedia control,** it lets you easily harness various audio and video inputs to enhance your animations, as well as output to video. Input types include MIDI files, waveform audio files, CD-based audio, digitized video, and analog video.

ANIMATION BASICS

Traditional animations, computer-based animations, digitized video, and even Hollywood movies all work on the same principle for creating the illusion of movement. When a number of static but sequential images are displayed quickly enough, the human mind links them together as a single fluid motion. Generally, a rate from 10 to 15 computer screens per second suffices for animation.

In traditional animation, each frame of a movie must be hand-drawn. Although some aspects of computer-based animation are still labor-intensive, much of the real grunt work is handled by the software. For example, in a traditional animation studio the head artist draws only the key frames for a particular sequence. Second- and third-tier artists draw the gradual changes—or *in-between* frames—to create smooth transitions and natural motion.

This process, nicknamed *tweening*, is an automatic function of animation software. To move an image from one side of the screen to the other, you first clip the image to a special buffer—called a *cel*—and then indicate the start and end positions for the move. The software automatically generates all of the in-between frames to create the illusion of movement.

The relationship between a cel and the path along which it moves can get quite elaborate. In programs that support multiple-frame cels, for example, the multiframe cel of a bird flapping its wings can be moved across the screen to make the bird fly.

Moreover, movement does not always involve "motion." Sometimes the goal is to create a dramatic wipe between scenes, or to transform one color into another. Animation programs handle these moviemaking tasks fairly easily with built-in wipes, palette manipulations, and image-processing features that let you add real drama to your films. For example, color cycling makes it easy to create blinking neon signs or the illusion of flowing water.

These programs even assist you with the most grueling aspect of 2-D animation—*tracing*. Since each frame in a 2-D animation is basically a flat picture, you create the illusion of a three-dimensional

PC MAGAZINE

EDITORS' CHOICE

- **Animation Works Interactive**
- **Autodesk Animator Pro**

It's hard for an animation package to serve two masters—the creative animator and the business presenter. Creative animation requires a sophisticated set of paint and movement tools; the high learning curve for these tools can interfere with a business user's need to generate quick-and-dirty graphics.

The $495 Animation Works Interactive has easy-to-understand commands, vector paths that are a breeze to edit, and access to scalable fonts—all the key features a business user needs. In addition, Animation Works does a better job than any of the programs we reviewed when it comes to sophisticated control over presentation flow, incorporation of multiple media, and access to external devices. The product's only major drawback is slow playback, which should be taken care of by the time you read this.

Although Animation Works' path controls shine (it is the only program in this roundup that supports true hierarchical animation), the rest of its creative animation capabilities do not even begin to match those of the $795 Autodesk Animator Pro. The sophistication of the painting tools alone earns Animator Pro high marks for creative animations: The program is hard to learn, but capable of just about any effect once you have invested the time. The Poco interpreter is unique among this group of programs; you do have to be comfortable programming in C in order to use it, however. The higher-resolution fonts that come bundled with the package are perfect for business users, and you can also use PCL4 soft fonts.

Animator Pro's low-cost relative, the $199 Autodesk MultiMedia Explorer, isn't as powerful as Animator Pro, but it still does a great job. The efficient DOS-based playback utility makes distribution a breeze, and more sophisticated playback is possible with the Windows utility. The process of accessing sound files and using the primitive (but effective) synchronization tools is easy. A wide range of sound formats, dialog-box scripting functions, and fade-in/fade-out capabilities make this a useful presentation program—if you don't mind its MCGA limitation.

PC Animate Plus has mediocre paint tools, but if you are willing to import your images, you can take advantage of the package's excellent set of animation effects. It handles the highest-resolution video modes, although its fonts are low-resolution. The playback utility is feature rich, with looping commands and the ability to alter the playback speed on the fly. In addition, you can (with programming help) extend the playback utility to add branching and to trigger outside devices, such as CD-ROM drives.

Deluxe Paint Animation gets high marks for creative work simply because its painting tools are so good, although its MCGA-only resolution may put off more advanced artists. Likewise, the product probably has the most accessible simple path controls in the group. On the other hand, its odd typefaces and proprietary file format make it difficult to recommend for presentation work.

Action!'s toolset is well suited for business users—it is simple and direct—and the text is high-quality. But poor performance, especially when incorporating audio, and too-simple playback controls render it frustrating for presenters. Conversely, creative animators will feel constrained by the dearth of paint tools.

object turning in space by manually drawing each of the different views. The most efficient way to draw a properly aligned series of pictures is to keep tracing over the image from the previous frame. Computer programs can simulate tracing paper, showing the previous (or following) frame as a visual guide.

TOWER OF BABEL

The basic abilities to create cels, define paths, trace the previous frame, and apply special effects are common to most of the dedicated computer animation programs. But you'd never know it, because each software vendor refers to these functions by a different name.

For example, Autodesk Animator (part of the Autodesk MultiMedia Explorer package) calls a multiframe cel an *anim*^{cel}, which is the same as an *Animbrush* in Deluxe Paint Animation or an *actor* in Animation Works Interactive. Even a simple feature like tracing has several different names, including *blue frames*, *onion skin*, and *ghosting*. For example, PC Animate Plus uses *tweening* with the historically correct meaning, which is the automatic creation of in-between frames; Autodesk's Animator uses the same word to refer to polymorphic shape interpolation.

Jargon is not the only difference among these six products. They run the gamut in price, graphics capability, and ease of use. The most important distinction, however, is that four of the programs—Autodesk Animator Pro, Autodesk MultiMedia Explorer, Deluxe Paint Animation, and PC Animate Plus—are bitmapped products, while Action! and Animation Works Interactive create object-oriented, vector-based animations.

Each frame of a raster (bitmapped) movie is actually a collection of pixels that change over time and are not easily edited. Once you have painted or rendered a motion effect, you have permanently altered the file. Vector animations, on the other hand, consist of objects and instructions, which are usually easier to edit because you can change an object's attributes or reshape the path along which elements move. But the trade-offs between the two technologies become even more important at playback time.

SHOW TIME!

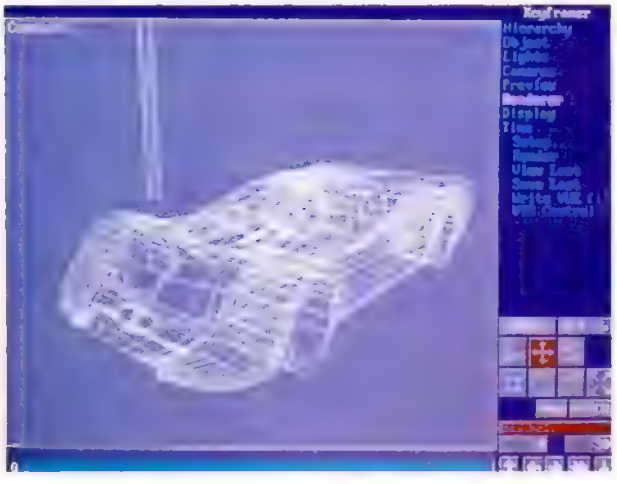
Ultimately, a program's working performance is secondary to playback speed: Without fast playback there is only a convulsive series of static pictures. Raster animations often deliver better playback performance because they merely update the screen. After all, displaying a series of images isn't processor-intensive, although at higher resolutions it can eat up valuable RAM and give your video card a real

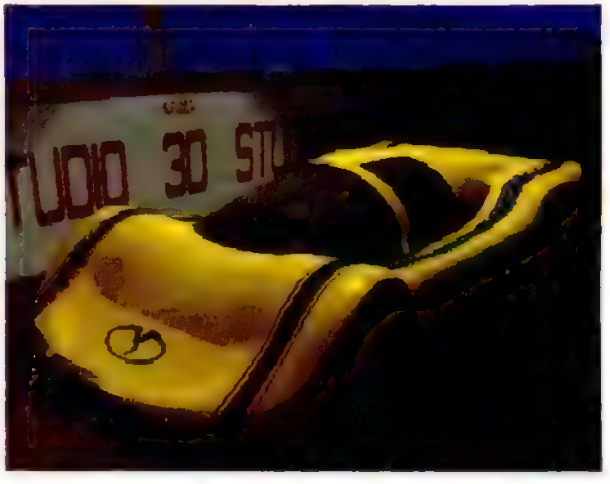
Keyframing Unlocks the High End

by Luisa Simone

Animation software that costs $300 generally has the same features as animation software that costs $3,000, with the exception of *keyframing*. Keyframe animation is most closely associated with high-end 3-D vector-based animation programs, such as Topas Animator, from AT&T Graphics Software Labs, or 3D Studio, from Autodesk, although it is an integral part of the high-end 2-D product Rio Animator, from AT&T Graphics Software Labs.

Topas and 3D Studio allow you to control the way 3-D objects interact as they move through a logical 3-D space. Keyframing lets you set up the pivotal scenes (or the key frames) in an animation, usually using only wireframe representations of the objects. The program then generates all of the in-between frames automatically and renders the movie using sophisticated surface modeling techniques and anti-aliasing. These programs are the correct choice if realism is your goal, because they can make any object or scene look totally believable.





Working with a final rendered version of an animation can be impossibly slow, especially if you are dealing with 3-D objects, high-resolution images, or high color depths. To speed up this process you can work with wireframe representations (left) and render the entire sequence when it is completed (right). You can also use a wireframe representation as a special effect in your final product.

workout. Raster-based playback performance is not just a matter of adapter speed versus processor power, however. Lots of RAM can help: For example, both the Autodesk products and Deluxe Paint Animation let you preload movies into memory for faster playback.

Each time you play a vector-based movie, on the other hand, the program must recalculate the direction of the path, interpret any formatting commands, and re-create the motion effects. This processor-intensive task can make playback unacceptably slow.

Both types of programs tend to need a lot of horsepower. Even running on a 33-MHz 486 system with 4MB RAM, several of the programs suffered. With only 4MB of memory (the minimum required), Autodesk Animator Pro will interrupt your work flow while it spools some portion of your animation to disk. Though Action! and Animation Works Interactive require only 2MB RAM, if you plan to work with Microsoft Windows with Multimedia Extensions to add audio to them, even 4MB of memory is insufficient.

Compromises can speed things up a bit. For instance, you can improve performance by using a 16-color palette instead of a 256-color palette. Lowering the resolution and animating only small portions of the screen can also result in smoother playback.

Videotape is without a doubt the most efficient way to distribute animations, especially since it doesn't require any particular hardware other than the ubiquitous VCR. Optional VGA-to-NTSC conversion hardware allows you to generate reasonable-quality VHS or Super VHS tapes. Action! even has an internal Print to Video command, although you still have to cue the tape manually.

If you plan to have your animations run from floppy disks, or if you're going to distribute them in that format, you'll want a small, efficient playback utility—which is more of a problem than you think. Even though Animation Works Interactive and Autodesk MultiMedia Explorer supply separate playback utilities, you still need Windows to run them. PC Animate Plus requires that all of its video and sound drivers be copied along with the player program, eating up valuable disk space.

Of course, raster-based programs are the real disk hogs. All of the raster programs conserve disk space by analyzing the individual frames in a movie and saving only the *deltas*—the changes—between sequential frames. Consider this: A 20-frame Animator Pro file at a resolution of 640 by 480 pixels with 256 colors occupies only 232K when sequential frames are similar. Another 20-frame flic (Autodesk refers to its animations as *flics*) at the same resolution requires 1.2MB of disk space when the frames are radically different from one another. Microsoft's RLE (run length encoded) file format, which stores only the differences between sequential frames in an animation to compress it, is a standard format with growing support.

If you incorporate animations into multimedia presentations, accessing external devices is an important consideration.

MAKING MOVIES

The tasks you need to perform will determine which package is best for you. Business users with text-intensive presentations should look for programs that support high-resolution scalable type or canned text effects. Both Action! and Animation Works Interactive run under Windows and work well with TrueType or Type 1 fonts (via Adobe Type Manager or Bitstream FaceLift for the latter).

Artists who want to produce evocative images should look for robust painting tools and sophisticated painting techniques like anti-aliasing, colorizing, and transparency. These paint functions are exponentially more powerful if they can be applied over multiple frames. Only the Autodesk products allow you to soften, emboss, or jumble images as you render a multiframe animation.

If you intend to import images from different sources—canners, paint programs, or clip-art libraries—you should pay special attention to a program's palette capabilities. All of the programs in this roundup use 256-color, indexed palettes. Digitized photographs, transparency effects, or anti-aliasing techniques, however, require lots of subtle transition shades in order to look good. The ability to cut and paste colors or to squeeze an image down to its essential hues is an important feature if you ever hope to reconcile conflicting palettes.

If you need to incorporate your animations into multimedia presentations, accessing external devices, such as sound boards, is an important consideration. Animation Works Interactive stands head and shoulders above the competition on this score, because it lets you insert automatic video and audio events or trigger them with a mouse click. Both Action! and Animation Works also support creator-defined buttons that allow your audience to navigate around a presentation. For a higher level of interactivity, you have to go to a multimedia authoring package, such as AimTech Corp.'s Icon Author. In addition, all of the products that run under Windows take advantage of Multimedia Windows. Even PC Animate Plus supplies no-frills multimedia by supporting Sound Blaster .VOC files.

One of the easiest ways to whip up a presentation is to use canned effects whenever possible. We used Macromedia's wonderful source tool, ClipMedia; the first volume, titled Business and Technology, contains royalty-free graphics, animations, digitized video, sound effects, and music files. Similarly, the globe in our animations is part of the Autodesk Animator Business and Communications clip library. The Autodesk Animator format is becoming a de facto standard. Two of the non-Autodesk products reviewed here—Animation Works Interactive and PC Animate Plus—can import or convert the .FLI and .FLC formats. You can convert and play a Macintosh-created Macromedia Director movie under Windows; this support for the .MMM format makes a recognized standard for playing animations within Windows.

Entering the world of animation is a lot like jumping into the deep end of the pool. At first you will definitely be in over your head, but once you get into the swim you will be buoyed along by your own creativity and the sophisticated tools of your animation software.

Macromedia

Action!

A buzz of anticipation accompanied the introduction of Action!, Version 1.0.1, a $495 presentation program for Microsoft Windows. Little wonder, since Action! was developed by the same company that brought MacroMind Director (now called Macromedia Director)—and accessible multimedia computing—to the Apple Macintosh. Unlike its Mac sibling, however, Action! is specifically geared to business users instead of professional artists. And unlike those of its Mac sibling, Action!'s results are mixed.

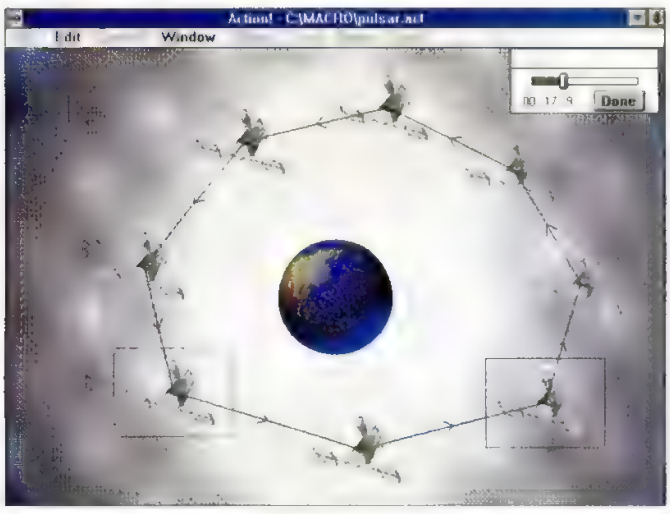
Action! is built on three premises basic to business graphics programs. First, Action! uses the slide metaphor common to programs such as Aldus Persuasion and Microsoft PowerPoint, in which a thumbnail view of your presentation allows you to reorder slides with click-and-drag ease. The big difference is that an Action! *slide*—or what Action! calls a *scene*—has a specific duration and can contain animated elements.

Second, Action! offers an abundance of canned motion and transition effects. Based on the assumption that business users are more productive when they can click on options in a dialog box, the program's one-from-column-A-and-one-from-column-B approach to animation is highly reminiscent of older, DOS-based products such as Show Partner F/X and Storyboard Live! It's not the only way to animate elements within Action!, but it is the most accessible.

Third, Action! is fully vector-based and object-oriented. Although you can import bitmapped images, a picture is always treated as a discrete object.

The vector-versus-raster difference is crucial to understanding Action!'s strengths and weaknesses for animation. Since most business presentations still rely heavily on words, Action!'s ability to support scalable fonts via TrueType and Adobe Type Manager is a bonus. This avoids jaggy, low-resolution text—a problem common to animation programs. In addition, Action! can import Windows Metafiles, a common export format from illustration and presentation graphics packages. This makes it possible for users to base animations on data-driven charts generated with a graphing package.

Most important, object orientation allows users to assign and edit duration, movement, and transition effects like any other attribute. So changing an object's behavior is as easy as changing its color. For example, each element in an Action! presentation has three phases: Enter, Hold, and Exit. To slow an object's entrance, you merely open the Edit Object dialog box (or double-click on the object) and increase the duration of the enter phase. Action! carries out the new instructions on the next playback.



Action!'s Path Editor lets you draw irregularly shaped paths interactively. At playback time, the selected object moves along the path, while the program conveniently displays several copies of the object at various points along the way.

While in the Edit Object dialog box, you can also change other attributes. For instance, you can attach sounds—.WAV files or CD-audio—to objects or turn any object into a button to transport you to other scenes in your presentation.

SUITABILITY TO TASK

Action!

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	●	○
Creative animation	●	○	○	○
Multimedia control	●	●	○	○

Action! also provides some very interesting tools for creating sophisticated motion effects. For example, Path Editor lets you draw each segment of a polyline move, as well as set the duration for each segment of the polyline path. Action! also offers ersatz hierarchical animation: Group individual elements that are moving in different directions and apply a new motion effect to the group, and on playback Action! will combine all of the instructions to create a more complex animation sequence. Perhaps the easiest way to include sophisticated motions in your presentations is to use MacroMind Director movies, because Action! can import .MMM files that have been converted for playbacks under Windows.

SLOW AND COMPLEX

Sound too good to be true? It is. While Action! brings some fresh ideas about animation and multimedia presentations to the PC, the implementation is flawed. One major problem is the sheer number of attributes that you have to coordinate. For example, though the opening segment of PC Magazine Labs' test animation contains only three objects and one sound file, we had to track 11 different timing attributes and remember which attributes are playback control functions, which are associated with scenes, and which are object attributes.

Action! does offer several tools intended to help manage attributes. An editable time line graphically displays the temporal relationship between the various elements in a scene. A Content List gives you both a summary of each scene and a shortcut to the Edit Object dialog box. Still, novice users should rely heavily on the supplied templates, merely replacing the sample text and pictures without editing the timing sequences.

Performance is the biggest drawback of object orientation. Like Animation Works Interactive, Action! must interpret and execute every display, transition, and

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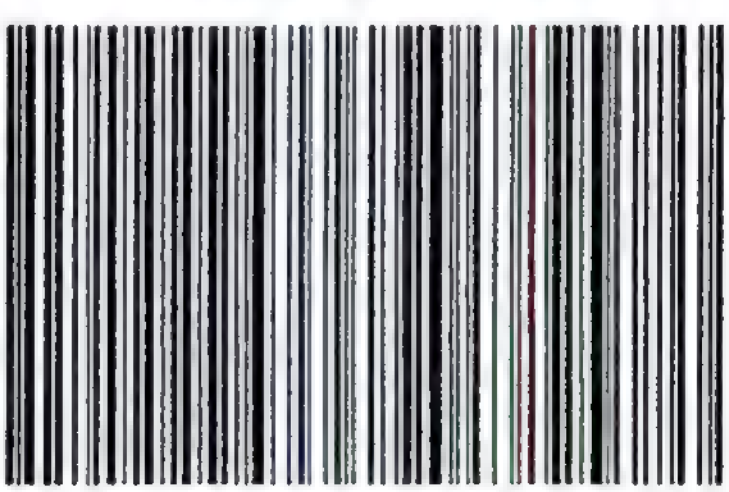

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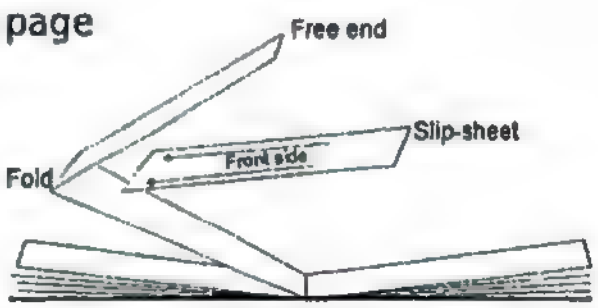

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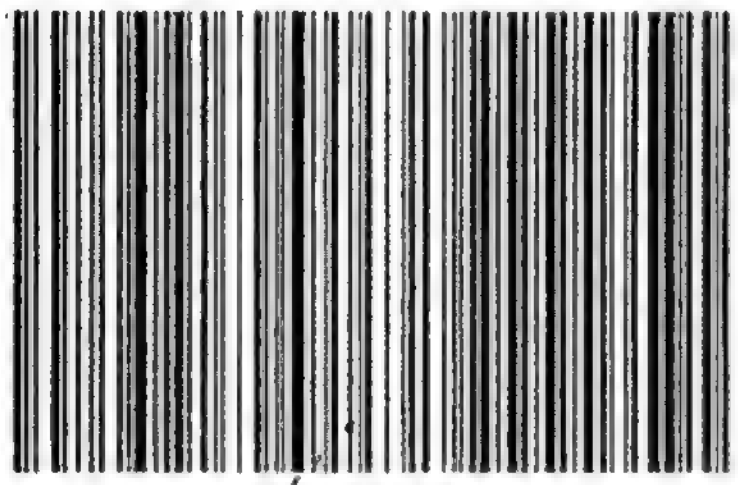

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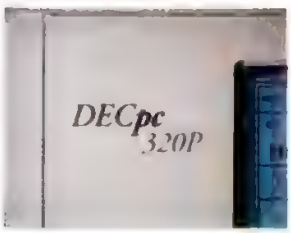

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- O Engineering
- O Scientific Research
- O E-Mail
- O Order-entry
- O Financial Calculations
- O Desktop Publishing
- O Design (CAD/CAM)
- O Industrial Process Control
- O Software Development
- O Other industry-specific applications (please specify)

Which of these graphics-oriented applications best describes your needs? (Check all that apply)

- O Desktop Publishing
- O CAD/CAM
- O Animation
- O Realtime Modeling
- O Image Processing
- O AutoCad
- O Business Graphics

How many people work in your group, department or small business?

- O Less than 10
- O 10-20
- O 20-35
- O More

Is your desktop operating system:

- O DOS
- O DOS with Windows
- O OS/2
- O MAC
- O UNIX™
- O VMS
- O Other

LAN Communication:

How many PCs do you have installed?
From how many manufacturers?
What kinds of connections does your PC(s) require? (Check all that apply)

- O Links with other PCs in the immediate surroundings
- O Connection to the local area network (LAN) throughout a building
- O A line to a host system in a remote location

What kind of media (cable) is used in your LANs today?
What is the networking software now being used in your company?

What kind of host system will your PC communicate with?

- O Digital
- O IBM
- O Other

What kind of service do you need?

- O On-Site Hardware Support
- O Software Support
- O Telephone Support
- O Training
- O FAX Hotline

How many of your users take portables on the road?
Do you currently have a service contract(s) for your PCs?

- O Yes
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move command each time you step through a scene. The result is a frustratingly slow response during both movie creation and playback; the movement of objects across the screen is downright twitchy. Even worse, you will find that sounds and movements alternately start and stop as they vie for processor time and RAM.

Further, we could not properly complete the test animation because of several other program limitations. For example, it proved impossible to have the satellite pass in front of the globe because the globe is an imported Macromedia Director .MMM movie file, which could not be layered underneath other objects (except other .MMM files).

Currently, Action! walks the fine line separating business graphics from animation programs. The forthcoming Version 2.0 crosses the line into businessland thanks to full-blown, data-driven charting functions. Macromedia (the new company name reflects the recent merger of MacroMind, Paracomp, and Authorware) also promises to support MIDI (Musical Instrument Digital Interface) sound and to provide a separate and faster playback utility (notable omissions from the current version).

Macromedia's 30-day money-back guarantee demonstrates the company's confidence in Action!, but *PC Magazine* must withhold its vote of confidence until Action! improves both its presentation management tools and playback performance.

FACT FILE

Action!, Version 1.0.1

Macromedia, 600 Townsend, San Francisco, CA 94103; 415-442-0200; fax, 415-442-0190

List Price: $495

Requires: 386SX-based PC or better, 2MB RAM, 1MB hard disk space, VGA display, Microsoft Windows 3.x 4MB RAM, 9MB hard disk space, 256-color graphics adapter, Microsoft Windows with Multimedia Extensions and compatible sound card recommended

In Short: Action! will appeal to business users who want to add movement, special effects, and sounds to their presentations with point-and-click ease. Slow performance and poor playback, however, mar an otherwise interesting product

Ⓒ N476 ON READER SERVICE CARD

Gold Disk Inc.

Animation Works Interactive

Animation Works Interactive, Version 1.02, shows all the signs of becoming a classic animation product. The powerful tools in Gold Disk's animation program let you add movement, sound, digitized video, and even interactivity to imported images. More important, Animation Works implements these tools so well that even difficult techniques and concepts become easy to master. Best of all, it costs only $495.

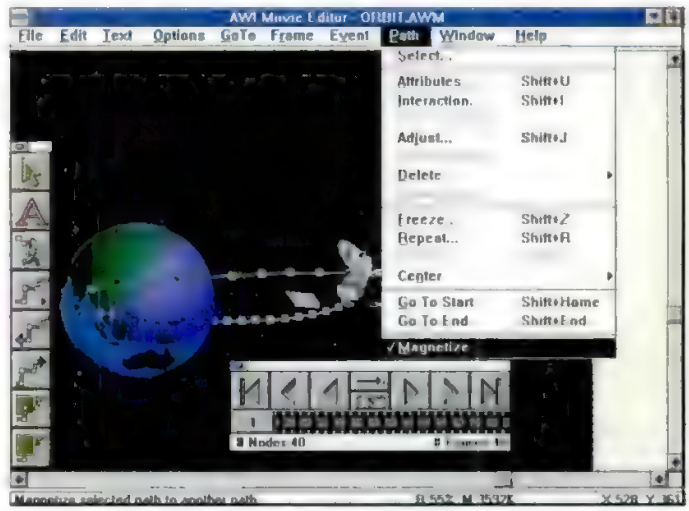
Animation Works takes a divide-and-conquer approach to moviemaking by supplying three separate modules: the Background Editor, the Cel Editor, and the Movie Editor. You use the Background Editor and the Cel Editor to import and prepare bitmapped images for use in the Movie Editor. One word of warning: These two modules are intended to *edit* pictures you create with other programs. So while they are strong on import filters and manipulation functions, neither is up to the job of creating images from scratch.

For example, you can import .BMP, .PCX, RLE, and even Autodesk Animator .FLI files into the Cel Editor, and then rotate, flip, or size the pictures across multiple frames. But once you get past creating simple outlines, you will find the painting tools deficient. You can't create gradient fills for foreground elements or employ any special painting techniques, such as blend or soften. If you use the zoom tool, you will find yourself facing an old-fashioned fat-bit editing window. The Cel Editor does provide an onion-skin function to help you trace the previous frame, however.

The advantages of working with separate modules become apparent when you proceed to the Movie Editor. In contrast with the Background and Cel Editors, the Movie Editor is vector-based and object-oriented. This enables you to create, edit, and enhance paths easily. In turn, paths control the movement of *actors*—which is Animation Works' term for multiframe cels—in your presentation.

Instead of drawing tools, the Movie Editor toolbox contains pathing functions. If you've ever used a vector drawing program, however, you will find that most of the path tools work identically. For example, the straight line, freehand, curved, and closed polygon tools operate by simply clicking and dragging the mouse in order to generate a path along which the current actor moves.

Whenever a pathing function might be too complicated to manipulate directly, a dialog box pops up to make things easier for you. For instance, after you draw a path, Animation Works presents you with a dialog box where you indicate the number of frames for the motion effect. In the same way, one of the toolbox's more sophisticated functions—the Gravity tool—appropriately lets you draw the starting point and direction of a path onscreen. The path is actually determined by parameters, however, such as G-force and initial speed, that you set in an associ-



The Magnetize command on Animation Works Interactive's Path menu allows you to create hierarchical motions almost effortlessly. Here a child (the satellite) is linked to a parent (earth) and will orbit around the earth even as the earth spins along on its own elliptical path.

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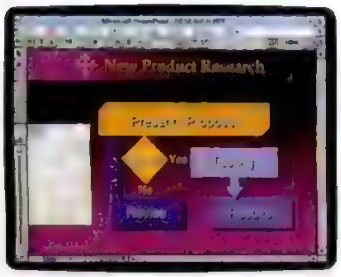

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ated dialog box. Because the program displays all of the nodes in a selected path simultaneously, changing the shape of a path is as simple as selecting a node and dragging it to a new location.

Business users will get a lot of use out of the Text Transition tool, which allows you to place type elements in their ending position and then apply motion effects. Using the Text Transition tool limits you to canned effects, but it does allow you to access any Windows font, including scalable TrueType and Type 1 typefaces (via a type manager).

DIRECTING THE ACTORS

Animation Works also provides elegant tools that help coordinate the movement of several different actors. Impressively, you can change the way paths are layered on-screen—to create the illusion of objects passing behind or in front of one another—by sending one segment of a path backward in the stacking order and another segment of the same path forward in the stacking order. Even complex animation effects, like hierarchical motion, are easy to understand and even easier to achieve. Linking the satellite's orbit to the earth's elliptical path in our test animation required only three mouse clicks.

There is only one major limitation to the paths you can create. Paths are always linear and always reside in the *x* and *y* dimensions, so you cannot create spins or change the size of an actor from within the Movie Editor. Also, to change the direction of a path (ping-pong or backward, for example) you must manually re-create the vector. You can, however, create these effects using the Cel Editor. On our tests, we produced a multiple-frame actor complete with a spin and a size change in order to create the illusion of a satellite getting smaller as it traveled back in space. We then chose the Ping-Pong cel sequence to return the satellite to its starting size by the end of the orbit. But the limited power of the Cel Editor's painting functions caused rasterization on the rotated and resized versions of the satellite image.

Despite its reliance on vector paths, Animation Works is still a frame-based animation program, which makes it easy to navigate your movies. In addition to the current picture, a frame can contain events that occur automatically when you play the movie. These events include new backgrounds, wipes, loops, pauses, and playback of sound or digitized video. Animation Works provides simple dialog boxes to access MIDI, .WAV, and CD-audio. You can save yourself some heartache if you contact Gold Disk about its new MCI interface before you try to incorporate digitized video into your presentations.

In addition, Animation Works lets your audience trigger any of these events by using the keyboard or clicking the mouse. This sophisticated level of interactivity can include playing sounds or video on demand. It is also very easy to achieve,

Every Movement Has a Meaning of Its Own

anti-aliasing A process that makes jagged lines appear smoother by using intermediate colors along the boundaries of objects.

cel Short for *celluloid*. In traditional animation, clear sheets of plastic (cels) were stacked on top of one another to form a complete picture (or frame) and then photographed. In computer-based animation programs, a cel is an image clipped from all or part of a frame. Some animation programs can create multiframe cels.

color cycling Flashing through a set of predefined colors to give the appearance of motion.

compositing An editing technique that pastes one animation over another.

frame An individual picture representing a moment in time. A series of frames displayed in sequence forms a movie.

frames per second The unit of measurement used to indicate the proper playback speed for an animation. Typically, PC-based animated movies play at 10 to 15 frames per second. *Jiffy* is a way to control playback speed that inserts pauses between the individual frames of an animation.

in slow/out slow In computer-based animation, an automatic effect that accelerates or decelerates a cel while moving it across the screen to achieve more natural motion.

in-betweening Also known as *tweening*. Traditionally, this is the process of manually creating all transitional frames in order to give the illusion of movement. Computer-based programs can generate in-between frames automatically. See *morphing*.

key color A term borrowed from video-editing systems. A color chosen to be clear or transparent during paste operations and compositing. It is usually applied to cels so that the foreground image within the cel is visible, but the background color is transparent.

masking Protecting parts of the current screen image so that ink cannot be applied.

morphing Short for *metamorphosing*, the process of automatically transforming one shape into another over a specified range of frames (for instance, changing a square into a circle). Morphing is similar to the polymorphic blending found in vector-based drawing programs. Some programs refer to *morphing* as *tweening*.

onion skin To display a faint copy of the previous cel while editing the current cel to match object positions precisely or create an accurate trace. *Automatic blue frame* is a similar technique in which the previous (or following) cel is displayed in light blue.

pathing Determining the motion of an object by mapping out the path it will follow over a specified range of frames.

ping-pong To move an element or play an animated sequence forward, backward, and then forward again repeatedly.

wipes Also known as *transition effects*. Wipes are methods of ending one scene and moving to another. They clear the screen in one of several ways, including fade-outs, white flashes, and sweeps.

***x, y, z* screen coordinates** In 2-D programs, locations within a coordinate system based on the number of pixels displayed on-screen. The *x* and *y* dimensions are based on the width and height of the screen (for example, 640 by 480 pixels), respectively. The *z* dimension simulates the third dimension, or depth. For example, an object moving along the *z* dimension will become smaller and appear to be traveling back in space.

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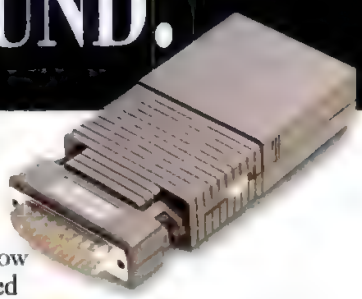

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CIRCLE 093 ON READER SERVICE CARD

because you simply attach the event to an actor's path instead of to a frame.

Right now, Animation Works' biggest problem is performance. When you are creating animation, you must keep all of the actors in your movie available as resources. This lets you quickly switch between different actors, but it also eats up valuable RAM and slows down response time.

SUITABILITY TO TASK

Animation Works Interactive

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	●	●
Creative animation	●	●	○	○
Multimedia control	●	●	●	●

Equally as serious, the package's player program (a utility that lets you freely distribute your movies) is unusually awkward and often slow. The awkwardness stems from the fact that you must laboriously copy several dynamic link libraries (DLLs) as well as the executable program file to a floppy disk in order to play back your animations. And, as with Action!, the other object-based package we reviewed, each time you play a movie Animation Works must interpret the instructions for each actor and re-create the motion effects.

Don't misunderstand: Animation Works makes a valiant attempt to play back movies correctly. For example, the program had no trouble playing both movie and sound files simultaneously. The screen refresh rate left a lot to be desired, however. Gold Disk is currently working on the right solution to this problem. Version 1.1 of Animation Works Interactive, due out in the third quarter of 1992, will be able to compile your animations for distribution. This will result in a single executable file that will contain both the movie and a playback utility. Best of all, the compiled animation will use Microsoft's RLE (run length encoded) compression technology. RLE ensures faster playback times because it stores only the differences between sequential frames in an animation.

Animation Works proves that vector-based animation can provide tools that are powerful enough for professional artists and easy enough for nonprofessionals. With the necessary improvements to playback performance, this will be one dynamite moviemaking program.

FACT FILE

Animation Works Interactive, Version 1.02

Gold Disk Inc., 5155 Spectrum Way, Mississauga, Ontario, Canada L4W 5A1; 800-465-3375, 416-602-4000; fax, 416-602-4001

List Price: $495.

Requires: 286-based PC or better, 2MB RAM, 2MB hard disk space, VGA display, DOS 3.3 or later, Microsoft Windows 3.x. 386-based PC or better, 5MB hard disk space, Microsoft Windows with Multimedia Extensions and compatible sound board recommended.

In Short: The Movie Editor module of Animation Works Interactive lets you create and edit paths that range from simple straight lines to true hierarchical motion. A stellar interface makes it easy to add interactivity and multimedia audio or video to your animations. Weak painting tools and unacceptably slow playback times are the only areas that need improvement.

477 ON READER SERVICE CARD

Autodesk Inc.

Autodesk Animator Pro
Autodesk MultiMedia Explorer

Both its name and its $795 price tag are clues that Autodesk Animator Pro, Version 1.0, is not for casual users. But its amazing range of two-dimensional animation tools render it the program of choice for users who seek true artistic control over their animations.

Animator Pro's low-resolution little brother, Autodesk Animator, Version 1.0, contains many of the sophisticated animation and painting tools found in Animator Pro, including all of the pathing options, palette manipulations, and flic special effects (Autodesk's animations are called *flics*.) Autodesk has also made purchasing Animator more appealing by bundling it with the Autodesk Animation Player for Windows and over 150 clip-art movies, and selling it as a $199 package, Autodesk MultiMedia Explorer, Version 1.0.

The capabilities of the two DOS-based products overlap quite a bit. The Animator programs are the only ones in this roundup to offer true shape interpolation, which Autodesk calls *tweening*. Also, they are the only programs that contain automatic text effects, including scrolls (characters typed sequentially) and the ability to reuse copy stored in a buffer.

Of course, Animator and Animator Pro also offer all of the standard 2-D animation tools, accessed through eight different modules (Optics, Tween, Inks, Tools, Frames, Anim cel, Palette, and Titling). On the most basic level, you can mimic the traditional animation technique, tracing, with automatic blue-frame insertion. Animator also contains a small but useful selection of special effects that can be applied globally to movies. For example, you can create motion blurs using the Trails effect.

The most powerful animation method on this impressive list of animation techniques is pathing, accessed via the Optics module. The Animator programs can move cels along complex paths defined by *x*, *y*, and (simulated) *z* coordinates. In addition to direction instructions, paths can include spins, size changes, closed polygons, and variable speeds.

Although you can use slider bars to define most movements, it is often easier to draw the path interactively on-screen. A perfect illustration of this is the clocked path, where Animator (and Animator Pro) not only notes the direction of your mouse movement but the speed as well. The program then uses both the shape and the timing to render the effect—in the process creating naturalistic movement.

This laundry-list approach to the programs' features does not adequately convey the intelligence that informs many of the programs' functions. For example, they can squeeze palettes down to include only those colors used in the current frame, and can even analyze an entire animation to create a single palette for all of the frames in your flic. These features allow you to reconcile wildly conflicting palettes—an essential tool if you intend to use imported images (each with its own unique palette) in an animation.

Before you can animate elements, you have to create them. Here, too, the Animator products score high points with robust paint capabilities based on a unique

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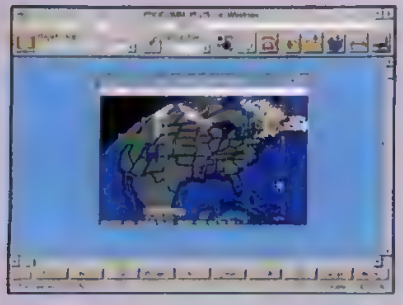

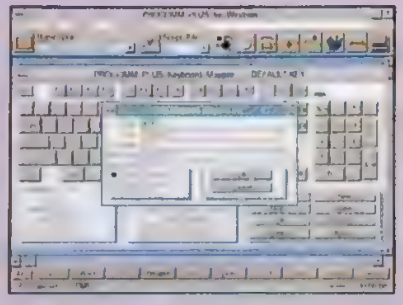

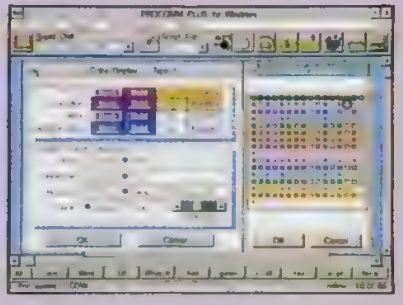

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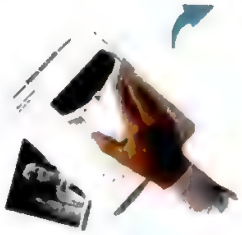

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LOGITECH

CIRCLE 182 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

2-D Animation Software

Products listed in alphabetical order ■ = YES □ = NO	Action!	Animation Works Interactive (PC EDITORS' CHOICE)	Autodesk Animator Pro (PC EDITORS' CHOICE)	Autodesk MultiMedia Explorer	Deluxe Paint Animation	PC Animate Plus
List price	$495.00	$495.00	$795.00	$199.00	$134.95	$199.95
General Information						
Environment	Windows	Windows	DOS	DOS and Windows	DOS	DOS
Total amount of memory required	2MB	2MB	4MB	640K; 2MB for Windows Player	640K	640K
Disk space required	1MB–9MB	2MB–5MB	11MB–20MB	6MB–10MB	3MB	2.3MB
Supports digitizer	□	□	■	■	□	□
Interactive operation	■	■	□	□	□	□
Macro recorder	□	□	■	■	□	□
External links	□	■	■	□	□	■
Highest resolution supported	1,024 x 768 x 256	1,280 x 1,024 x 256	1,024 x 768 x 256	320 x 200 x 256	320 x 200 x 256	1,280 x 1,024 x 32,000
Runtime player	□	■	■	■	■	■
On-line help	■	■	□	□	□	□
File Formats						
Import/export:						
.BMP	■ □	■ ■ (import only for actors)	□ □	□ □	□ □	■ ■
.CLP	■ ■	□ □	□ □	□ □	□ □	□ □
EPS	■ □	□ □	□ □	□ □	□ □	□ □
.GIF	■ □	■ ■ (import only for actors)	■ ■	■ ■	□ □	■ ■
.IFF and .LBM (Deluxe Paint)	□ □	□ □	■ ■	■ □	■ ■	□ □
MacPaint	□ □	□ □	■ ■	■ ■	■ ■	□ □
.PCX	■ □	■ ■ (import only for actors)	■ ■	■ □	■ ■	■ ■
.TGA	□ □	□ □	■ ■	■ □	□ □	□ □
TIFF	■ □	□ □	■ ■	□ □	■ ■	■ ■
.WMF (Windows Metafile)	■ ■	□ □	□ □	□ □	□ □	□ □
Multimedia formats (import only):						
AVI/DVI	□ □	■ ■	□ □	□ □	□ □	□ □
.FLI/.FLC (Autodesk)	□ □	■ □	■ ■	■ ■ (.FLC playback only)	□ □	■ ■
MIDI/Waveform	□ ■	■ ■	□ □	■ ■	□ □	□ □
.MMM (Macromedia Director)	■	□	□	□	□	□
RLE	□	■	N/A*	N/A*	N/A*	N/A*
Animation						
Creation methods:						
Onion skin	□	■	■	■	□	■
In-betweening	■	■	■	■	■	■
Shape interpolation	□	□	■	■	■	□
Pathing:						
Automatic close path	□	■	■	■	■	□
Spline path	□	□	■	■	■	■

N/A*—Not applicable. This feature does not apply to vector-based programs

CONTINUES

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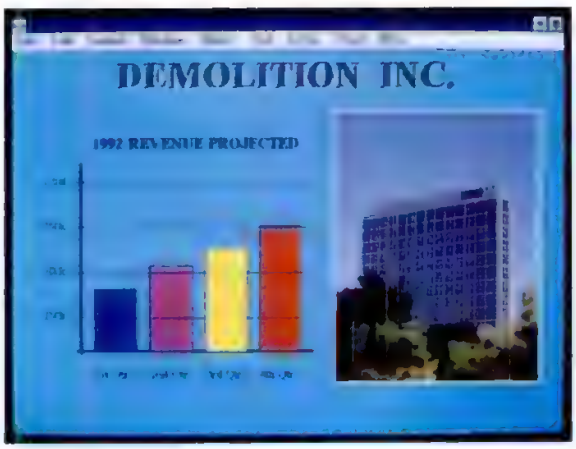

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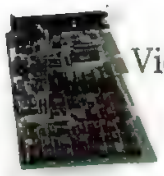

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CIRCLE 086 ON READER SERVICE CARD

2-D Animation Software

SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES □ = NO	Action!	Animation Works Interactive (PC Editor's Choice)	Autodesk Animator Pro (PC Editor's Choice)	Autodesk MultiMedia Explorer	Deluxe Paint Animation	PC Animate Plus
Animation (continued)						
User can edit path interactively	■	■	■	■	□	□
Multiple-frame cels	□	■	■	□	■	□
Interframe controls:						
In Slow/Out Slow	□	■	■	■	■	□
Looping	■	■	■	■	■	■
Ping-pong	□	■	■	■	■	■
Reverse	□	■	■	■	■	■
Cel controls:						
Paste behind	■	■	■	■	□	■
Spin (*x,y,z*)	□	□	■	■	■	■
Built-in effects:						
Anti-aliasing	□	□	■	■	■	■
Color cycling	□	□	■	■	■	■
Dissolve/fade	■ □	□ □	■ ■	■ ■	□ □	□ ■
Loop segment	□	□	■	■	■	■
Pixelate	□	□	■	■	□	■
Simulate gravity	□	■	□	□	□	□
Number of wipes	40 (to solid color only)	16	16	3	None	5 (to solid color only)
Can set key color	□	■ (via MCI command)	■	■	■	■
Compositing	□	■	■	■	□	■
Hierarchical linking	■	■	□	□	□	□
Rotate	□	■	■	■	■	■
Flip and mirror	□	■	■	■	■	■
Creation tools:						
Grid	■	□	■	■	□	□
Crosshair cursor	■	■	■	■	□	□
User can cut, copy, and paste across frames	□	■	■	■	■	■ (paste only)
Text Controls						
Font support:						
Font types supported	Type 1, TrueType	Type 1, TrueType	Proprietary, PCL4 bitmap	Proprietary	Proprietary	Proprietary
Range of type sizes	Unlimited	6–500 points	Fixed sizes, 6–48 points (supplied fonts)	Fixed sizes, 6–48 points	Fixed sizes, 8–96 pixels	Fixed sizes, 8–36 points
Text-alignment and style options:						
Aligns text on baseline	■	□	■	■	■	□
Indents text	■	■	■	■	□	□
Left/center/right text alignment	■	■	■	■	□	□
Rotates text	□	■	□	□	□	□
Text animation	■	■	■	■	□	□
Text buffer	□	□	■	■	□	□
Text effects	■	■	■	■	□	□

CONTINUES

▶ SUMMARY OF FEATURES

Products listed in alphabetical order ■ = YES ☐ = NO	Action!	Animation Works Interactive (EDITORS' CHOICE)	Autodesk Animator Pro (EDITORS' CHOICE)	Autodesk MultiMedia Explorer	Deluxe Paint Animation	PC Animate Plus
Paint Tools						
Object creation:						
Line	■	■	■	■	■	■
Oval	■	■	■	■	■	■ (circle only)
Polygon	☐	☐	■	■	■	■
User can choose number of sides	N/A†	N/A†	■	■	☐	☐
Free-form polygon	N/A†	N/A†	■	■	■	■
Polyline	■	■	■	■	■	■
Rectangle	■	■	■	■	■	■
Object outline	■	■	■	■	■	■
Airbrush	☐	■	■	■	■	■
Control air speed	N/A†	☐	■	■	☐	■
Control density	N/A†	☐	■	■	■	■
Gradient fills	■ (background only)	■ (background only)	■	■	■	☐
Angled	☐	■	☐	☐	■	N/A†
Horizontal and vertical	■	■	■	■	■	N/A†
Radial/selectable focal point	■ ☐	☐ ☐	■ ■	■ ■	■ ■	N/A†
Color controls:						
Average	☐	■	■	■	☐	■
Blend	☐	☐	■	■	■	☐
Fade	☐	☐	■	■	☐	■
Invert	☐	■	■	■	☐	☐
Remap palette	☐	■	■	■	■	■
Smooth	☐	☐	■	■	■	☐
Soften	☐	☐	■	■	☐	☐
Transparency	■	☐	■	■	■	■
Color models:						
HLS/HSV	☐ ☐	☐ ☐	■ ☐	■ ☐	☐ ■	■ ☐
RGB	☐	■	■	■	■	☐
Masking	☐	☐	■	☐	■	☐
Output						
To hardcopy:						
HP PaintJet	■	■	■	☐	■	☐
HP DeskJet	■	■	☐	☐	☐	☐
Color PostScript	■	■	☐	☐	☐	☐
Film recorders	■	☐	☐	☐	☐	☐
To video	■	☐	☐	☐	☐	☐
NTSC-specific palette	■	N/A†	N/A†	N/A†	N/A†	N/A†
Support						
BBS	Macromedia	None	CompuServe	CompuServe	None	CompuServe
Free technical support hours (Eastern time)	12:00–7:00 (first 90 days only)	9:00–6:00	12:00–8:00	10:00–8:00	12:30–7:30	12:00–8:00

N/A†—Not applicable. The product does not have this feature

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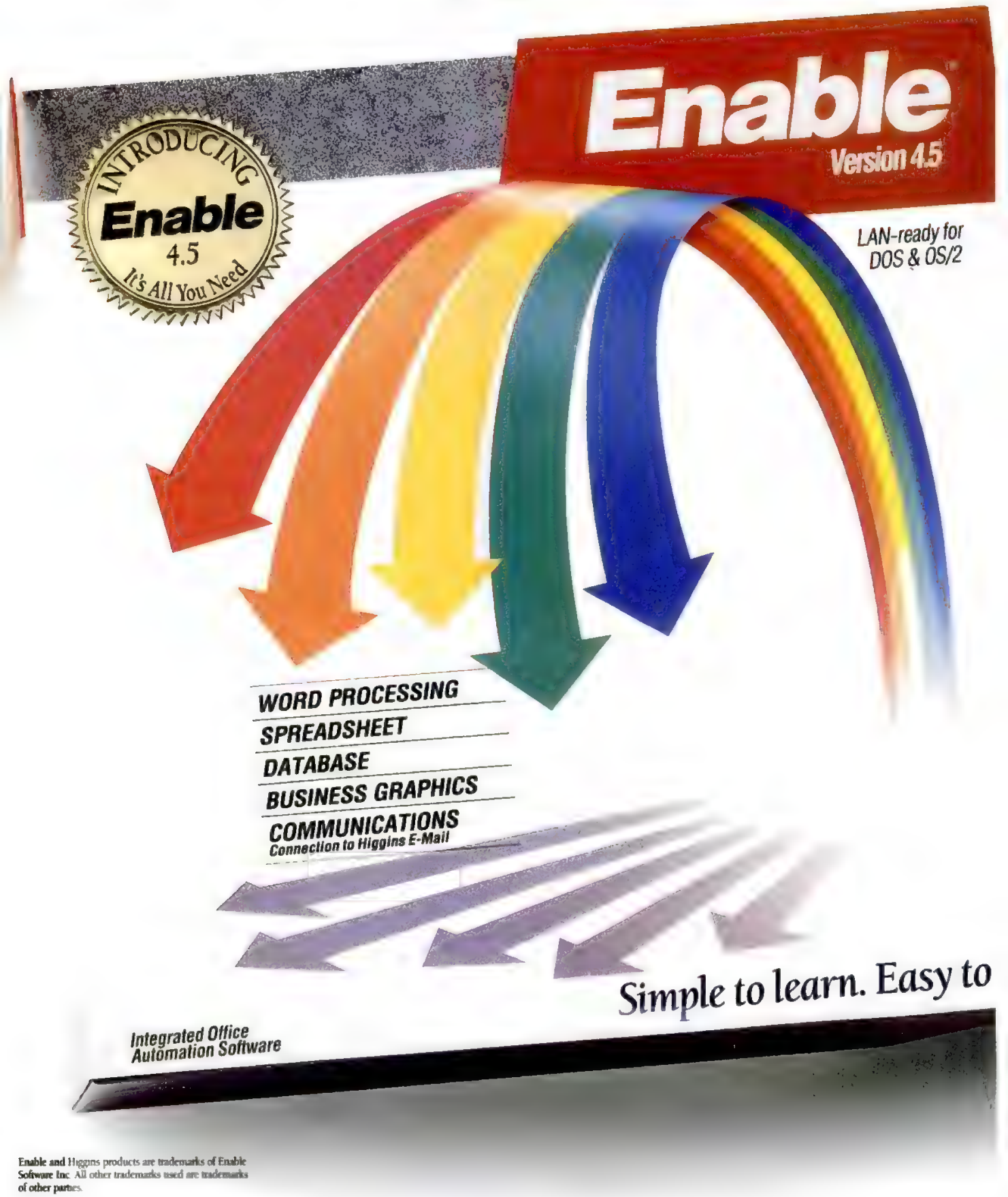

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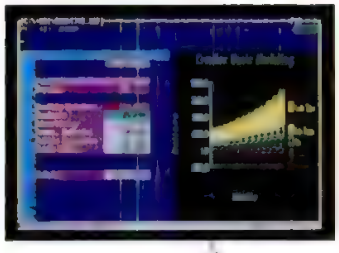

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SUITABILITY TO TASK

Autodesk Animator Pro

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	●	○
Creative animation	●	●	●	●
Multimedia control	N/A			

threefold approach to image creation. Each time you put your brush to the screen, you can choose one of 22 tools, one of 256 colors, and one of 33 inks. (Ink choice determines how color will be applied to your painting; for example, if you choose glass ink, you will be painting with transparent color.)

ECCENTRIC INTERFACE

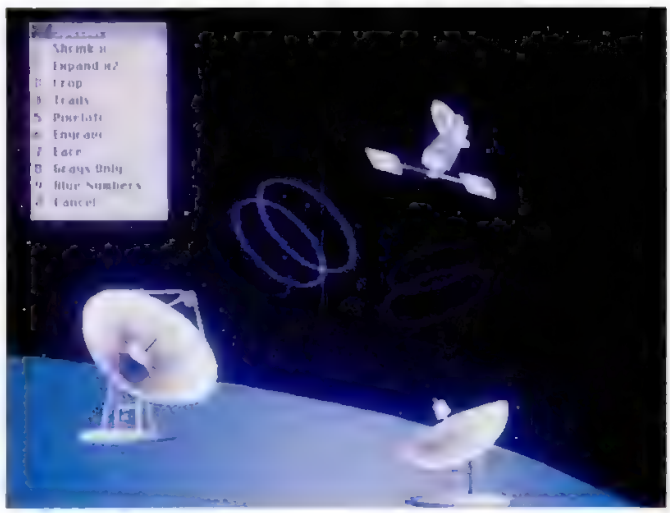
Creating an animation requires using all of the functions simultaneously—in fact, to master the programs you will have to learn how various settings and options interact. For example, in one of our test animations we simulated the churning surface of the sun during solar flare activity by creating a tweened shape, saving it as an anim cel, selecting the current painting mode as One Color, defining a path, and choosing Jumble ink. When we rendered this sequence, we created a special effect where the pixels already on-screen were disrupted in a moving pattern.

Unfortunately, coordinating all of the various options and settings that influence an animation is a bear of a job. To complete the effect described in the previous paragraph successfully, we had to navigate among the Tween, Anim cel, Optics, Inks, and Time Select panels.

This task is made even more difficult by the completely idiosyncratic interface used on both of the products. An arbitrary command structure, cluttered dialog boxes, and icon buttons that are positively confusing leave you only one way to learn this program: brute-force memorization.

In fairness, Autodesk has made some efforts to fine-tune Animator Pro's interface. The changes are most noticeable when you compare Animator Pro with its predecessor, Animator. Where Animator Pro provides a separate and more understandable module dedicated to tweening, Animator forces you to dig deep within the tools configuration panel in order to access tweenable polygons. And although it seems like a small point, the new Redo button in Animator Pro can save you lots of work by letting you repeat the most recent action using a different ink or brush.

With about a $600 price differential between the two products, common sense dictates that there are other significant differences as well. Animator Pro runs in protected mode, and it can take advantage of high-end hardware to access extended memory directly and to display images up to 1,024-by-768. As an entry-level program, Animator lives within the confines of 640K and the MCGA resolution of 320 by 200 pixels. While Animator Pro can work with multiframe cels, Animator is restricted to a single-frame cel. And only Animator Pro offers true program extensibility in the form of the Poco utility, a C-language interpreter that allows third-party developers and end users to extend and enhance Animator Pro's functions. Poco programs can be used to create spectacular special effects (such as a moving-star field) or to handle the drudgery that sometimes accompanies the animation process (such as automatically converting sequentially numbered picture files into a movie).



We used Autodesk Animator Pro's Trails effect, which left behind a faint shadow for each radio wave, and combined it with a straight-line path, an increase in size, and color cycling to simulate a radio wave dissipating as it travels through space.

On the other hand, Animation Player for Windows (or "Windows Player"), which comes packaged with Animator, allows you to create playback scripts—complete with loops, fades, and pauses. Many of the commands are identical to the parameters used with the DOS-based playback utility that accompanies both packages. But these commands are easier to access within the Windows Player because you can use dialog boxes, option buttons, and scroll bars.

Windows Player can also take advantage of Microsoft Windows with Multimedia Extensions to access a broad spectrum of sound formats, including .WAV and MIDI files, as well as CD-audio. The ability to set a negative delay—starting the audio before your animation appears on-screen—is a straightforward and highly effective way to sync sounds to flics. Unfortunately, you can import only one sound file per flic.

Testing revealed that the most serious limitation of Windows Player is the overhead of Windows itself. Only low-resolution (320-by-200) flic files displayed full-screen played back smoothly. Although Animation Player for Windows accepted the high-resolution flics we created with Animator Pro, the screen refresh is so slow that you see a ripple effect as the pixels are updated from frame to frame. Without the overhead of Windows, the DOS-based playback utility for Animator Pro (AniPlay) did not exhibit any speed problems with higher-resolution images.

SUITABILITY TO TASK

Autodesk MultiMedia Explorer

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	○	○
Creative animation	●	●	●	○
Multimedia control	●	●	●	○

Despite a truly eccentric interface, Animator Pro delivers flexible and powerful animation tools. If you are serious about animation, this is the program for you. And if you want the power without the price and can live with low resolution, you'll be equally satisfied with MultiMedia Explorer.

FACT FILE

EDITORS' CHOICE

Autodesk Animator Pro, Version 1.0

Autodesk MultiMedia Explorer, Version 1.0

Autodesk Inc., 2320 Marinship Way, Sausalito, CA 94965; 800-525-2763; fax, 415-491-8308

List Price: Animator Pro, $795; MultiMedia Explorer (includes Autodesk Animator, Version 1.0, and Autodesk Animation Player for Windows), $199

Requires: For Animator Pro: 386SX-based PC or better, 4MB RAM, 11MB hard disk space, VGA display or better, DOS 3.3 or later, mouse. For MultiMedia Explorer: 286-based PC or better, 640K RAM, 6MB hard disk space, DOS 3.1 or later, VGA display, mouse or SummaSketch tablet. Windows Player requires 2MB RAM, Microsoft Windows 3.x (386-based PC, 2MB RAM, Microsoft Windows with Multimedia Extensions and compatible sound board recommended)

In Short: Autodesk Animator Pro, the most expensive product we reviewed, requires high-end hardware and has a steep learning curve. But sophisticated painting tools and a breathtaking array of animation functions are worth the extra cost and effort. The entry-level Autodesk Animator is limited to low-resolution movies (MCGA only!). But the toolset compares favorably with that of the more expensive Animator Pro, and the Autodesk MultiMedia Explorer package adds real value in the form of bundled clip-art movies and access to sounds at playback time (via the Windows Player program)

378 ON READER SERVICE CARD

Electronic Arts Inc.

Deluxe Paint Animation

Deluxe Paint Animation, Version 1.0, from Electronic Arts, doesn't require a major investment of either time or money. At only $134.95, it is the least expensive program in this roundup, yet its robust painting tools and easy-to-learn animation functions give you all the power you need to create dynamic animations.

In addition to standard painting tools, such as ellipses and brushes of various sizes, Deluxe Paint offers heavy-duty image creation functions. You can use the anti-aliasing option to smooth jaggies, the perspective tool to simulate 3-D space, and one of several different brush techniques, such as smooth, smear, or colorize, to polish your pictures.

Many of the animation functions are built on these painting tools. In fact, painting across multiple frames of an animation is as simple as holding down the Alt key and using the regular tools. Likewise, color cycling effects in Deluxe Paint Animation mimic the color cycling in Deluxe Paint II Enhanced, the classic painting program on which this package is based.

To create more sophisticated animations, you employ these same functions, but you configure the paint tools and use *custom brushes* (Deluxe Paint's term for a clip or cel). For example, to create an elliptical path for the satellite in our test animation, we simply clipped the satellite to a custom brush and configured the spline tool to draw a curve with a fixed number of dots. Holding down the Alt key while drawing the actual curve instructs Deluxe Paint to render one instance of the custom brush at each dot position in the curve across sequential frames.

The package contains several unique features not found in its sibling paint program, including the ability to work with *Animbrushes*, more commonly known as *multiple-frame cels* or *sprites*. You control apparent speed and the direction of the motion within the Animbrush via a special dialog box. For example, if you set the duration for twice as long as the number of frames in the Animbrush, then choose the backward option, you can render the Animbrush in slowly and in reverse.

Deluxe Paint also offers a special Move dialog box that gives you precise control over motion effects. You can move and spin a brush (either single or multiframe) along the *x*-, *y*-, and simulated *z*-axes, as well as create smooth loops and ease slowly into a movement, to add meaningful nuances to your paths. You can even render motions backward from an ending position or switch between screen axis and brush axis (an essential feature for realistic rotation and perspective effects). Once you've created a movie, you can distribute it with the bundled playback utility. This program can display individual picture files as well as complete animations, and can also loop segments to create self-running demos.

SUITABILITY TO TASK

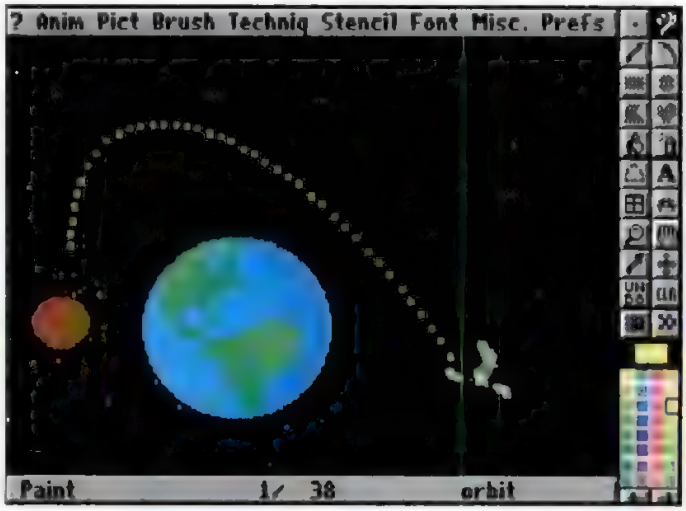
Deluxe Paint Animation

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	○	○
Creative animation	●	●	●	○
Multimedia control	N/A			

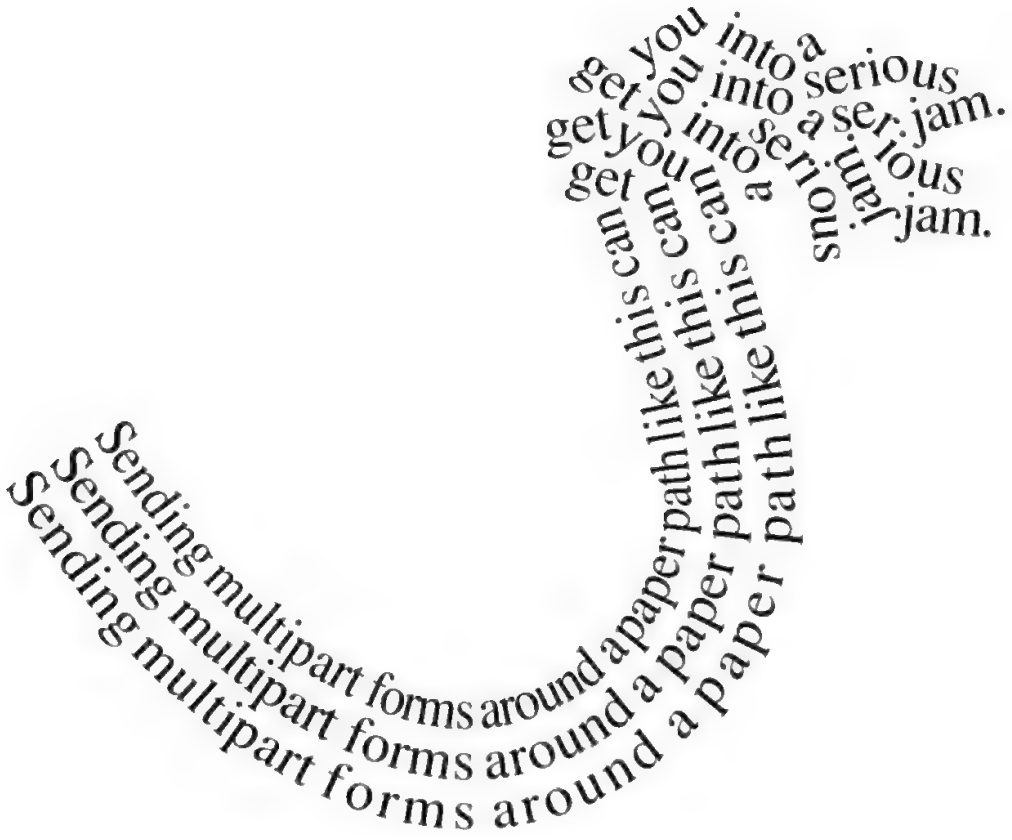
LIMITED SOPHISTICATION

Deluxe Paint's sophisticated features are equaled only by its limitations. For example, the Move dialog box can only generate straight-line paths. Special painting techniques (like translucence) do not work across multiple frames of an animation. Also, the program cannot generate blued frames or onion skins.

In all fairness, Deluxe Paint does an admirable job of living within the constraints of a raster-based program. So although the program does not support true tweening (which requires vector information to transform one shape into another), it does offer a raster-based morphing



Deluxe Paint Animation allows you to create irregular paths interactively on the drawing screen. This spline path contains 40 points. Each point represents the position of the custom brush (the satellite) on each frame in the animation.



IBM PPS II Dot Matrix Printers.

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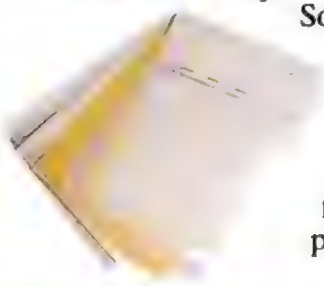

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FLAT-OUT-RELIABLE IBM PPS II

function. Basically, you can load two bitmapped brushes into memory, create a gradual blend between them, then save it as an Animbrush. We used this technique in PC Labs' test animation to create free-form solar flares. Similarly, you cannot composite two animations together, but you can composite a static image (stored in the Spare Page buffer) behind an animation running in the foreground. During testing we used this one-step procedure to paste a star-filled night sky behind all of the frames in the logo sequence.

The package supports only one video mode—320 by 200 pixels with 256 colors—but this constraint, along with the ability to run in only 640K RAM, ensures that it will operate on even low-end PCs. Despite its shortcomings, Deluxe Paint Animation is a great choice for those who want an inexpensive way to indulge their creative urges.

FACT FILE

Deluxe Paint Animation, Version 1.0

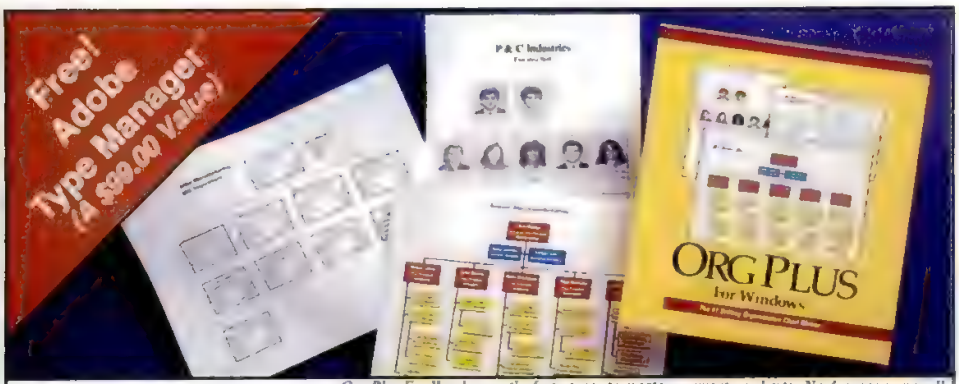
Electronic Arts Inc., 1450 Fashion Island Blvd., San Mateo, CA 94404; 800-245-4525, 415-572-2787; fax, 415-571-7993

List Price: $134.95

Requires: 640K RAM, 3MB hard disk space, VGA display, DOS 2.11 or later, mouse

In Short: What do you get when you combine Deluxe Paint Animation's fluid painting tools with its robust pathing functions? A program that lets you create and animate beautiful pictures. Deluxe Paint Animation is limited to 320-by-200 resolution, but it costs less than $135

479 ON READER SERVICE CARD



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April 29, 1992

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CIRCLE 351 ON READER SERVICE CARD

Presidio Software Inc.

PC Animate Plus

PC Animate Plus, Version 2.0, from Presidio Software, works hard to streamline the animation process. The $199.95, DOS-based program does a good job of organizing complex animation functions into logically constructed menus and dialog boxes.

For example, several different menus contain an F/X command (shorthand for special effects). The consistent use of the phrase helps you quickly learn that the F/X command controls motion effects, image-processing effects, or palette effects, depending on whether you're in the Frames, Draw, or Color menu.

The Frames F/X dialog box is the heart and soul of PC Animate Plus. On the simplest level you can spin, size, and move elements across the screen by adjusting slider bars for the *x*-, *y*-, and (simulated) *z*-axes, or by using the mouse interactively on the drawing screen. It's a breeze to create a continuous loop, or to convert a line path into a spline curve. In addition, push-button options let you paste elements over or under the images already on the screen, and make the key color (or the picture colors) transparent.

SUITABILITY TO TASK

PC Animate Plus

	POOR	FAIR	GOOD	EXCELLENT
Business presentations	●	●	●	○
Creative animation	●	●	○	○
Multimedia control	●	●	○	○

PC Animate Plus offers a number of different animation techniques. For instant gratification, try the Pixel F/X dialog box, which lets you transform single frames or entire films using one of 12 different special effects. You can create progressive pixelations, venetian-blind wipes, or surface ripples simply by clicking an option button. Likewise, the Palette F/X dialog box allows you to generate color cycling effects easily or fade an animation out to a solid color. If you are fond of traditional animation (where you manually trace an image from frame to frame), PC Animate Plus also displays a blued guide of the previous frame for copying or modifying.

The package provides more subtle effects as well. By reversing the direction of the segment arrow you can render an effect backward—an essential technique when you need to pinpoint the exact ending position of an element. And instead of animating a single-frame clip, you can apply motion effects to the current animation, or to a file stored on-disk. Since you can load multiframe animations into the Frame F/X buffer, this last option is a great way to composite animations.

FACT FILE

PC Animate Plus, Version 2.0

Presidio Software Inc., 2215 Chestnut St., San Francisco, CA 94123; 415-474-6437; fax, 415-474-6349

List Price: $199.95.

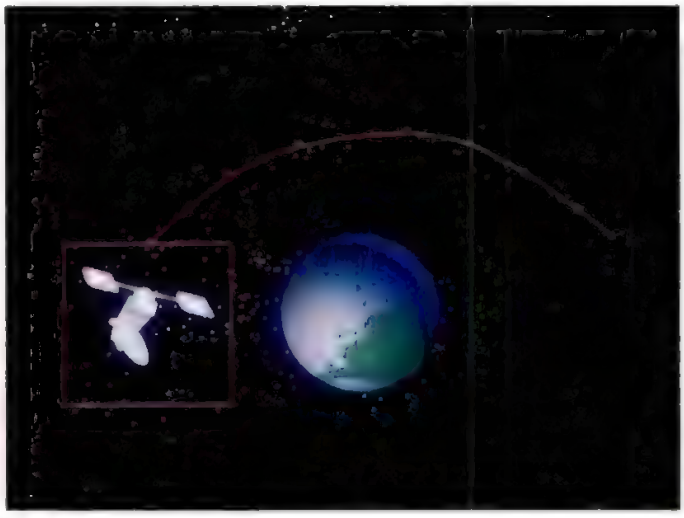
Requires: 640K RAM, EGA display, DOS 3.2 or later, mouse. 386-based PC or better, 2MB RAM, hard disk, VGA display recommended.

In Short: This low-cost animation package can add sophisticated movement to preexisting images (like scans and screen captures), but it is short on painting tools. Support for high-resolution video boards and the ability to annotate presentations with sound (via Sound Blaster files) are valuable bonuses.

ON READER SERVICE CARD

POOR PAINTING

The painting functions are the Achilles' heel of PC Animate Plus. You cannot modify any of the basic tools; for example, you cannot draw ellipses or arcs—only circles. You can't size the bitmapped fonts above 36 points. Although you can create a gradient in the palette, you can't use it to shade an object. Worse, when you invoke the zoom tool, you're transported to an old-fashioned fat-bit editing mode that forces you to click on individual pixels to alter an image.



In PC Animate Plus, we created a spline path (for the satellite clip to travel along) by drawing it directly on-screen. Notice that you cannot display any menus or dialog boxes while you are drawing—an inconvenience at best.

You cannot display the painting screen and the command screen (which contains the menus and palette) simultaneously, making painting even more awkward. The most serious drawback of this scheme is that it deprives you of visual reminders of both the current and key colors—important information for most animation functions.

You can, of course, circumvent this problem by importing an image. PC Animate Plus imports images in a variety of formats, including TIFF, .PCX, and .GIF. In addition, a bundled utility program can convert Autodesk Animator and Autodesk Animator Pro flics to PC Animate Plus's proprietary format.

The program does not support true masking. The workaround involves pasting elements behind the images on-screen or designating the picture colors as transparent. This pseudo-mask, however, is only in effect during a paste operation and cannot be applied to a specific area of the screen. As a result, you'll have to plan your animation carefully. During testing we discovered that pasting the satellite behind the earth also pasted it behind distant stars. In order to have the satellite pass behind the earth but in front of the stars, we had to re-create the animation and add the background last.

Most serious, when you preview a motion effect you see only a square wireframe moving across the screen, making it difficult to judge positioning accurately. One of our test animations required a curved shape to move between a satellite and a dish. Imagining how the curved shape fit within the square wireframe and then estimating where the curve would come to rest was an exercise in frustration.

The program deserves praise for its ability to work in high-resolution video modes up to 1,024 by 768 pixels with 256 colors. And although the palette controls are not always up to the task, the program can handle the 32,000 colors possible with the Tseng/Sierra chip combination.

A runtime playback utility and the ability to create simple loops within an animation are invaluable tools if you plan to distribute self-running presentations. In addition, built-in support of the Sound Blaster audio file format makes PC Animate Plus an inexpensive way to dabble in multimedia.

PC Animate Plus gives you high-resolution animation techniques for an incredibly low price. The painting tools are limiting, but if you are willing to import images from other applications, you will find that this package has the power and flexibility to move the images—and your audience. □

LUISA SIMONE IS A CONTRIBUTING EDITOR TO *PC MAGAZINE* AND THE AUTHOR OF *MICROSOFT PUBLISHER* MICROSOFT PRESS.

UTILITIES

Save Multiple Items to the Clipboard With CLIPSTAC

BY RICHARD HALE SHAW

The Windows Clipboard overwrites its entire contents the moment you copy a fresh piece of text or cut a second image to it. The Clipboard can hold one and only one item at a time; it is absolutely unforgiving. And, as you may have found, it takes just one accidentally lost cut to make you wish the Clipboard could accommodate multiple items.

CLIPSTAC eliminates this dangerous limitation. CLIPSTAC creates a stack, or history list, of all the texts and bitmaps that any program cuts or copies to or from the Clipboard. It saves all these items in a file, CLIPSTAC.DAT, from which you can copy items back to the Clipboard by selecting the desired entry from a list box, as shown in Figure 1.

Thus, anything you put onto the Clipboard can be retrieved and reused, day after day, from one Windows session to another. This not only safeguards your work, but makes the Clipboard a natural place to store and access frequently used logos, boilerplate texts, and the like. CLIPSTAC works equally well with both Windows 3.0 and 3.1.

The easiest way to get a copy of CLIPSTAC is to download it from PC MagNet, as explained in the sidebar "Utilities by Modem." The executable file is available as CLIPST.EXE, the C++ source code as CLISRC.ZIP, and documentation as CLIPST.DOC; all three of these files are archived in the CLIPST.ZIP file. If your modem setup can't handle binary files, you can download CLIPST.BAS, which, when run in BASIC, will create a copy of CLIPSTAC.EXE. If you wish to recompile the utility you'll need a C++compiler for Windows that supports templates. (I used Borland C++ 3.0; you can also use Microsoft C 7.0 or Zortech C++ 3.0.)

If you don't have a modem, you can get a disk with the program and source code by mail. Simply send a postcard indicating your name, address, and preferred disk size to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016. No phone calls, please.

You can copy, cut, paste, and store multiple items for repeated use on your Clipboard with this handy Windows 3.0 and 3.1 utility.

USING CLIPSTAC CLIPSTAC requires no special syntax or parameters. You can add it to a Program Group by choosing File, New from the Program Manager. Or you can choose File, Run and execute it from the command line simply by entering the following line:

```
CLIPSTAC
```

Probably the best way to take advantage of CLIPSTAC, however, is to set it up so that it loads whenever you run Windows. To do this, just check the Auto-Load item in the CLIPSTAC System Menu. This will put the full path of CLIPSTAC.EXE in the LOAD= entry of WIN.INI; each time you start Windows thereafter, CLIPSTAC will run as a minimized program. Alternatively, if you're using Windows 3.1, you can just add CLIPSTAC to your Startup group.

To terminate CLIPSTAC, just select Close from its System Menu or double-click on the CLIPSTAC System icon.

Once it's loaded, CLIPSTAC will open (or create) the CLIPSTAC.DAT file in your Windows directory. If the Clipboard already has something on it, CLIPSTAC will automatically retrieve a copy. (You can always retrieve additional copies of items in the Clipboard using CLIPSTAC's Paste button.) When you use CLIPSTAC to copy text or a bitmap to the Clipboard, CLIPSTAC will automatically make a copy and store it in CLIPSTAC.DAT.

The CLIPSTAC interface consists of a single dialog box with a list box and several buttons. Whenever you copy a new item to the Clipboard, a new entry is added to the beginning of CLIPSTAC's list, which is displayed in the list box. Each entry displays the date and time that the item was retrieved from the Clipboard, the format (text, bitmap, and so on), the size of the item, and, when available, the name of the program that put the item onto the Clipboard. For text items, CLIPSTAC also displays the first 21 characters of text in its Contents field.

A program can have more than one Clipboard *format*, or version of an item, in the Clipboard at a time. Because CLIPSTAC always retrieves as many different

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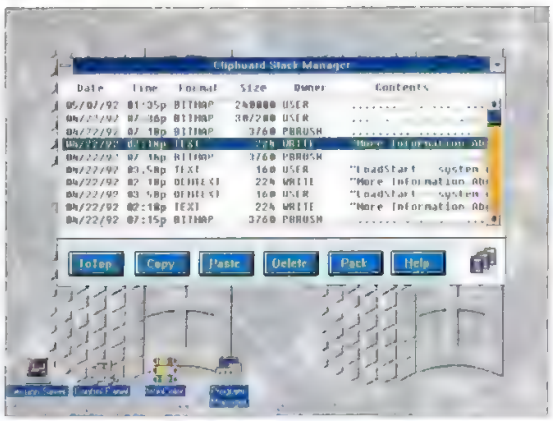

Figure 1: **CLIPSTAC automatically saves a copy of everything you cut and copy to the Windows Clipboard and lets you retrieve items by selecting them from a list box.**

item formats as are available, the same item will often appear (under different formats) more than once in CLIPSTAC's list. This is particularly true with text items, for which two character sets are available.

Typically, the program that puts an item onto the Clipboard is the Clipboard *owner*. But some programs (Notepad is one) do not access the Clipboard themselves; they use Windows' USER.DLL to access the Clipboard for them. In such a case the Clipboard owner will be the "User." (For more details about Clipboard formats and owners see the sidebar "Programming the Clipboard.")

You can select an item in CLIPSTAC's list by single-clicking on it with the mouse. (To select from the keyboard, Tab to the list and use the Arrow keys within the list.) Pressing the Copy button when an item is selected (highlighted) will copy that item from CLIPSTAC's list back onto the Clipboard. (Double-clicking on an item will accomplish the same thing.) Note that when you copy an item from CLIPSTAC to the Clipboard, CLIPSTAC will sense the change in the Clipboard and recopy the item to the top of its list—just as it would if any other program had changed the Clipboard's contents.

The Delete button removes a selected item from the list. The Paste button adds the item currently in the Clipboard to the top of CLIPSTAC's list. This is the same action that CLIPSTAC takes automatically when you change the Clipboard's contents. Paste, however, provides a convenient way to retrieve more than one copy of an item into CLIPSTAC's list without having to recopy it back onto the Clipboard from the program that put it there.

A QUICK TUTORIAL As all experienced Windows users probably know, you don't need to display the contents of Clipboard in order to make use of it. The Clipboard functions are available to applications whenever Windows is running. What you activate when you double-click on the Clipboard icon (or run CLIPBRD.EXE) is only the *Clipboard Viewer*. I suggest that you keep the Windows Clipboard Viewer open during your first experiments with CLIPSTAC so that you can monitor the Clipboard's contents at each step. You will also want to have CLIPSTAC open, of course, as well as a simple text editor (Notepad will do). It may take a little juggling to get them all on-screen at once, but the effort will be well spent.

Start by opening a file or typing some text into the Notepad window and using the mouse to select it. (You can also select text in the window by holding down the Shift key while you move the cursor to the end of the desired text.) Then use Edit, Copy or, from the keyboard, Ctrl-C (Ctrl-Ins in Windows 3.0) to copy the highlighted text to the Clipboard. Alternatively, you can use Edit, Cut or Ctrl-X (Shift-Del in Windows 3.0) to cut the text from the editor to the Clipboard. As soon as you cut or copy text to the Clipboard, an entry representing that text will appear in CLIPSTAC's list box, as described previously. Now delete the text in the Clipboard and from the application so you know that it is only available from CLIPSTAC.

To retrieve the text from CLIPSTAC back into your application, double-click

Utilities by Modem

The *PC Magazine* utilities are available by modem from PC MagNet, a ZiffNet service hosted by CompuServe.

To find the phone number nearest you, set your communications software to 300, 1,200, 2,400, or 9,600 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex, then dial 800-346-3247 with your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the number closest to you. Or you can call 800-635-6225 (voice) and follow the instructions and note the number.

To obtain the current issue's utility *free* of charges, dial the number nearest you; at the HOST NAME prompt, type CIS; at the USER ID prompt, enter 60116,1. At the PASSWORD prompt, enter PCMAGUTIL.

To join ZiffNet, at the USER ID prompt type 177000,5000. Then, at the PASSWORD prompt, enter PC* MAGNET. And finally, at the ENTER AGREEMENT NUMBER prompt, type PCMAG92.

Register your name and enter your MasterCard, Visa, or American Express card number. (If you'd like to have your company billed instead, call CompuServe at 800-848-8990.) Your personal user ID and a temporary password will be displayed. A new password will arrive in the mail within 10 days to confirm your subscription.

ZiffNet membership costs $2.50 per month. This includes access to *PC Magazine* Editors' Choice Awards, Product Reviews index, Weekly News from *PC Week*, Buyers' Market, ZiffNet Highlights, and the Support Forum (which also includes the current utility). CompuServe members can join by entering GO PCMAG at any CompuServe ! prompt.

If you access other areas, PC MagNet costs an additional $6.30 per hour for 300-bps service, $12.80 for 1,200 or 2,400 bps, and $22.80 for 9,600 bps. Billing is based on 1-minute increments.

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on the text's entry in CLIPSTAC's list box. (Alternatively, you can single-click on the entry and press CLIPSTAC's Copy button.) This will put the item from CLIPSTAC back onto the Clipboard. Then return to the target application, position the cursor where you want the text to be inserted, and select Edit, Paste or Ctrl-V (Shift-Ins in Windows 3.0). Voilà! The text will reappear in the target application's window.

To copy a bitmap from an application into CLIPSTAC, you use a procedure similar to the one you use for text. For example, to copy a bitmap from Paintbrush into CLIPSTAC, open Paintbrush and select File, Open to open a bitmap file (such as 256COLOR.BMP). Select the icon in the upper-right corner (the one with the scissors and a square) and select a portion of the bitmap. (Click and hold the mouse button at one corner of the bitmap and drag the mouse to the other end of the bitmap, then release the mouse button.)

Then use Edit, Copy (Ctrl-C or Ctrl-Ins) to copy the bitmap onto the Clipboard and so into CLIPSTAC. CLIPSTAC will display a new entry for the bitmap, though the Contents field will contain only dots. Clear the Clipboard once again to assure yourself that you're really making a copy from CLIPSTAC to the Clipboard in the next step.

Now, to copy the bitmap from CLIPSTAC onto the Clipboard, double-click on the bitmap entry in CLIPSTAC's list (or single-click it and press the CLIPSTAC Copy button). Then paste the bitmap from the Clipboard back into Paintbrush by activating Paintbrush, positioning the cursor where you want the bitmap to go, and using Edit, Paste (Ctrl-V or Shift-Ins).

MORE ON CLIPSTAC You'll notice when using CLIPSTAC that if you have more than ten entries in its list, you will not see new entries being added. The top of CLIPSTAC's list has simply scrolled off-screen. When this happens, a scroll bar will appear; you can use this to scroll through the list to the top of the stack. Whenever the top of the list is visible you'll see new items as they are added.

CLIPSTAC limits the number of items you can store in its list. The default is 500, but you can set a lower limit by making an entry in WIN.INI, as de-

Programming the Clipboard

As mentioned in the main text, CLIPBRD.EXE, which comes with Windows, is not itself the Clipboard. Rather, CLIPBRD.EXE is a Windows program that always displays the Clipboard's contents. The Clipboard itself is a facility, built into Windows, that allows for serialized, shared-memory I/O between multiple applications. Any Windows application can use Clipboard functions in the Windows API to open the Clipboard and read or change its contents.

CLIPBOARD FORMATS A Windows program can store or retrieve data from the Clipboard in one or more formats. There are nine different predefined Clipboard formats, as follows:

- two for text, using either the ANSI or OEM character set;
- two for bitmaps, one compatible with Windows 2.0 and the other a DIB (device-independent bitmap);
- one for Windows metafiles;
- a SYLK (Symbolic Link) format, used by Microsoft Multiplan and Chart;
- a DIF (Data Interchange Format), used by VisiCalc;
- a TIFF (Tagged Image File Format) for products such as Aldus's PageMaker; and
- a color palette format.

Which format a program uses varies. Word processors generally use text formats, while clip-art and drawing programs use bitmaps.

A program may store an item on the Clipboard in as many of the formats as it supports. Similarly, a program can retrieve an item from the Clipboard in as many formats as are available. If you use Notepad to copy text to the Clipboard, for example, Notepad will insert both of the text formats of the data into the Clipboard. Other programs, such as Microsoft Excel, use several formats to copy worksheets into the Clipboard: ANSI or OEM text, a bitmap, or DIF or SYLK formats. The worksheet can then be retrieved in any of these formats.

Since CLIPSTAC has no way of knowing which formats you'll want to use, it routinely saves *every* format that it can retrieve from the Clipboard. That's why, when you copy a block of text from Notepad to the Clipboard, you'll see CLIPSTAC save the text in both text formats. The Format column in CLIPSTAC can contain *most* of the formats I've mentioned. Specifically, CLIPSTAC supports both types of text and bitmap formats, plus DIF and SYLK.

ACCESSING THE CLIPBOARD CLIPSTAC uses a number of the Clipboard functions from the Windows API:

- OpenClipboard provides access to the Clipboard. Only one program at a time can gain access, and the program that has it becomes the Clipboard *owner*.
- EmptyClipboard deletes the contents of the Clipboard and prepares it for new data.
- GetClipboardData returns a handle to the Clipboard data for a particular format.
- SetClipboardData puts data in a particular format onto the Clipboard.
- CloseClipboard ends a program's access to the Clipboard and allows other programs to access it.
- GetClipboardOwner identifies the owner of the Clipboard.
- EnumClipboardFormats identifies which formats are available for the Clipboard's current contents.
- SetClipboardViewer adds a program to the *Clipboard viewer chain*, which will be discussed below.
- ChangeClipboardChain removes a program from the Clipboard viewer chain.

CLIPSTAC uses a C++ class, ClipBoard, that simplifies the use of these functions and encapsulates their functionality. So, for example, CLIPSTAC can call ClipBoard::Open, ClipBoard::Empty, ClipBoard::SetData, and ClipBoard::Close to change the contents of the Clipboard. The instance of class ClipBoard will often

CONTINUES

Programming Clipboard

CONTINUED

supply the appropriate parameters and information to the underlying Windows API functions. Because all the functions in class ClipBoard are in-line, they do not add any code to a program that uses them. Rather, they map directly to calls to the Windows API Clipboard functions, which you'll have in your program, anyway.

THE CLIPBOARD VIEWER CHAIN When a program changes the contents of the Clipboard, Windows sends a WM_DRAWCLIPBOARD message to the first member of the Clipboard viewer chain. This "chain" is a list of programs that are to be notified when the Clipboard contents change. CLIPBRD.EXE is an example of such a Clipboard viewer: Whenever you change the Clipboard, CLIPBRD.EXE will read the Clipboard's contents and display them in its window. While a Clipboard viewer program isn't required to display the Clipboard's new contents, it must pass the notification message on to the next viewer.

A program can become a member of the Clipboard viewer chain by calling the SetClipboardViewer API function. This function returns the window handle of the program at the beginning of the Clipboard viewer chain and puts the calling program at the beginning of the chain. When it gets a WM_DRAWCLIPBOARD message, the program must pass that message to the *next* Clipboard viewer—that is, the one that had been at the beginning of the chain prior to the call to SetClipboardViewer. If a program is exiting or no longer needs to receive the Clipboard notification messages, it should call ChangeClipboardChain to remove itself from the Clipboard viewer chain. (CLIPSTAC uses the ClipBoard::JoinViewers and ClipBoard::QuitViewer member functions to accomplish this.)

THE CLIPBOARD OWNER Programs in the Clipboard viewer chain can use the GetClipboardOwner function to determine which program has changed the Clipboard. CLIPSTAC uses this function (via ClipBoard::GetOwner) to obtain the owner's module handle and therefore the owner's name. (The owner's name consists of the filename and path of the .EXE file that controls access to the Clipboard.)

Sometimes, however, the Clipboard owner's name isn't available. On the one hand, when a WM_DRAWCLIPBOARD message is sent to members of the Clipboard viewer chain, the Clipboard owner still controls the Clipboard, and CLIPSTAC can obtain the owner's name. On the other hand, it is unusual for a program to retain ownership of the Clipboard any longer than is required to put new data onto it. (Indeed, it is considered poor Windows etiquette to do so.) Thus, chances are that when you push the Paste button, the Clipboard owner will already have relinquished control of the Clipboard. In this case CLIPSTAC can't obtain the name of the owner, so it puts (Unknown) in the Owner column instead.

At other times, the Clipboard owner name returned from Windows doesn't accurately reflect the name of the program from which the Clipboard data originated. For example, a program using Windows edit controls can send a WM_COPY or WM_CUT message to the edit control instructing it to copy or cut its contents to the Clipboard. But edit controls don't do this themselves; instead, they make calls into USER.EXE, the Windows DLL that contains most of the code for Windows. Since USER.EXE is the program that performs the Clipboard I/O for edit controls, USER.EXE is identified as the Clipboard owner in such circumstances. Thus, if you use Notepad (which is essentially a Windows edit control in a window) to cut or copy to the Clipboard while CLIPSTAC is active, you'll find that CLIPSTAC records USER.EXE, not NOTEPAD.EXE, as the Clipboard owner.

—Richard Hale Shaw

scribed below. This may be wise, especially if you use it for bitmaps; CLIPSTAC.DAT can easily grow beyond several megabytes if you use it to store many different bitmaps.

Items that you don't use again will eventually fall off the end of the list. That is to say, when you add the 501st item, the item at the bottom of the list will be discarded automatically. But whenever you use an item—that is, copy it from CLIPSTAC's list back onto the Clipboard—that item will also be copied to the beginning of the list. This safeguard will generally be enough to prevent a frequently used item from falling off the end of the list.

Just to be sure, however, CLIPSTAC provides a ToTop button. When you press this button, the selected CLIPSTAC item is copied to the top of its list *without* being copied to the Clipboard, where it would overwrite the current Clipboard contents. (Of course, this will push every item in the list down one notch.)

An additional CLIPSTAC feature helps deal with the disk-space problem that arises if you frequently use bitmaps. To appreciate the problem, press the Print Screen key while CLIPSTAC is running to copy a bitmap of the entire Windows desktop onto the Clipboard. (Depending on your computer, you may have to hit Print Screen twice, Shift–Print Screen, or Alt–Print Screen, as the Windows manual suggests.) CLIPSTAC's cursor will change to an hourglass while it copies the bitmap from the Clipboard into CLIPSTAC.DAT. When the bitmap entry appears in CLIPSTAC's list, you'll find that may be anywhere from 150K to a full megabyte, depending on your system's video resolution. All it takes is three or four of these and CLIPSTAC.DAT will balloon to several megabytes of valuable disk space.

To prevent this, wherever possible CLIPSTAC duplicates the information about a list item *without duplicating the item itself.* Thus, you don't have to worry about CLIPSTAC.DAT's size exploding if you frequently use Copy or ToTop. You can prove this to yourself by hitting the Copy button several times when the desktop bitmap you just made is highlighted. Now use the File Manager (or DIR in a DOS window) to check the size

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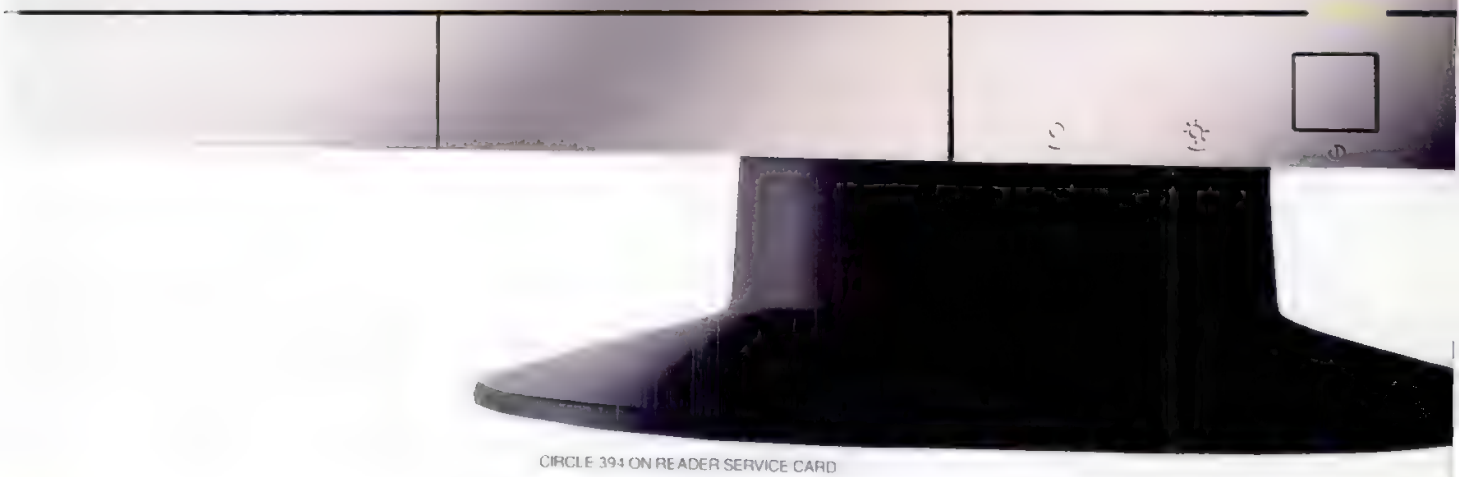

CIRCLE 394 ON READER SERVICE CARD

of CLIPSTAC.DAT. It will have increased only by the size of the original bitmap, not by the size of the additional copies.

You can control the number of items in CLIPSTAC's list in two ways. First, of course, you can use the Delete button to remove selected items from the list. As mentioned earlier, however, you can also reduce the default maximum number of items in the list by adding the MaxItems entry to the [ClipStac] section of WIN.INI. (CLIPSTAC will automatically create this section the first time you run it.) Thus, you might enter

```
MaxItems=100
```

to limit the number of entries in CLIPSTAC's list to 100. Whenever the number of CLIPSTAC items exceeds 500 (or the MaxItems setting, whichever is smaller), CLIPSTAC will drop the item at the end of the list. The CLIPSTAC About box reports the current number of items in the list; just select About ClipStac from CLIPSTAC's System Menu.

Whether a CLIPSTAC item falls off the end of the list or you use the Delete button to remove it, the item is not immediately removed from the CLIPSTAC.DAT file. As with many of the popular PC database programs, you must occasionally pack CLIPSTAC's data file to remove deleted items from the file and recover the disk space they occupied. When you press the Pack button, CLIPSTAC will write out a new copy of CLIPSTAC.DAT that contains only those items that are current in the list. And, wherever an item was created via the Copy or ToTop buttons, only a single copy of that item will remain in the entire data file.

Note that, as with PC database programs, packing can take some time, especially if CLIPSTAC's list gets large or contains large items. If you find yourself using Pack during every CLIPSTAC session, you can check the AutoPack option in CLIPSTAC's System Menu. This will cause CLIPSTAC to pack CLIPSTAC.DAT automatically each time you start the program.

HOW CLIPSTAC WORKS As a Windows program, CLIPSTAC makes use of Windows' graphical user interface. But dealing with the Windows API and with the usual setup and initialization features of a Windows program is notoriously messy and complex. For this reason I wrote a set of C++ classes—a small application framework—in order to encapsulate some of the Windows API and to handle the details of using it.

My class library supplies most of the setup and initialization code that you'd ordinarily have to write for yourself. CLIPSTAC's classes provide a number of services that simplify the processes of registering a window class, creating and displaying a window, and receiving and responding to messages. Additionally, they make it easy to standardize the behavior of an interface component and to create new components by deriving new C++ classes from old ones. As with most application frameworks, you need only derive one or two new C++ classes from those in the framework to get the basic application up and running.

Dealing with the Windows API and with the usual setup and initialization features of a Windows program is notoriously messy and complex.

Unlike such full-fledged application frameworks as Borland's Object Windows Library (OWL) and Microsoft C 7.0's Foundation Classes, however, the classes used by CLIPSTAC do not attempt to encapsulate the entire Windows API. I have expanded them to offer MDI (multiple document interface) features, but they don't encapsulate GDI (Windows' graphical device interface), DDE (dynamic data exchange), or OLE (object linking and embedding) services. You can add these, if you wish.

I chose not to use Borland's or Microsoft's application frameworks for reasons related to the very wide audience for which *PC Magazine* utilities are intended. Had I used an existing application framework, it would have effectively excluded everyone who doesn't use or have that particular framework. Moreover, even if you never intend to design an application framework yourself, you can get some idea of what is involved by seeing how I devised my own.

A further consideration was that I wanted to keep the program small and fast. Application frameworks like OWL force you to use either large or compact memory models, and OWL.DLL alone takes up 144K. Using it would hardly make sense, since CLIPSTAC.EXE is barely 35K and most users will get their copy by downloading it from PC MagNet.

CLIPSTAC'S CLASSES The principal C++ classes in CLIPSTAC are Window, WinApplication, WinDlg, and ClipStac. Window is the basic window class: It provides standard window setup and creation services as well as a virtual message–handling facility that maps member functions to Windows messages.

Virtual message handling is a system that lets you associate a member function of a C++ class with a Windows message. Consequently, when a particular Windows message—such as WM_PAINT—is received, a facility built into the application framework automatically calls the appropriate member function—WMPAINT()—of the object managing the window that received the message. The framework provides a default virtual member function for each Windows message. If you want your applications to behave differently, you can override the default functions with your own member functions.

The class Window (which is the designation I'll use to denote my C++ Window class) is derived from WinApplication. WinApplication provides application-wide services for storing the parameters passed to WinMain and for making them available to the entire application. WinApplication also lets you add a standard Windows message loop to your application by means of a single function call, Run().

The WinDlg class is derived from class Window. Thus, it inherits all its parent's functionality. WinDlg is designed to create a modeless dialog box as a window's main window. It assumes that you have created a dialog template with a dialog editor, such as the one supplied in Borland's Resource Workshop, in Whitewa-

ter's Resource Toolkit, or in the Windows SDK. To create the dialog, you then derive a new class from WinDlg and pass the name of the dialog template to the new class's constructor:

```
class ClipStac : public WinDlg
  {
  .
  .
  ClipStac(char *name) : WinDlg(name)
    {
    .
    .
    }
  };
```

Class Window contains a set of virtual member functions to implement message handling.

Virtual member functions may be overridden by defining them anew in a derived class. Thus, no matter how you access an object of the derived class—whether directly, or indirectly via a pointer to a parent of the derived class—a call to the virtual function will always return the most-recently derived version of that virtual function. In the code below, therefore, regardless of the level at which you call the foo function, its most-recently derived version will be the one that gets called:

```
class A
  {
public:
  virtual void foo(void);
  };

class B : public A
  {
public:
  virtual void foo(void);
  };
.
.
B B_object;
A *pointer_to_A_object = &B;
pointer_to_A_object->foo();
// calls B::foo()
```

C++ classes are the means by which new data types are created. In the illustration above, class A is a data type, and class B is a new data type derived from class A. If you access B::foo directly, you'll call B::foo. But if you use a pointer to a data

The CLIPSTAC API

CLIPSTAC has features that might be useful to programmers as well as end users. Thus, the idea for the CLIPSTAC API was born. The CLIPSTAC API consists of seven messages that CLIPSTAC defines and registers with Windows via the RegisterMessage function:

```
WM_CLIPSTACREGISTER
WM_CLIPSTACPUSH
WM_CLIPSTACPOP
WM_CLIPSTACFIND
WM_CLIPSTACGET
WM_CLIPSTACEXIT
WM_CLIPSTACDEREGISTER
```

Any Windows program written in C or C++ can use these messages simply by including the file CSAPI.H, calling RegisterMessage to register the name of each message with Windows, and returning a message value. (Programs written in Turbo Pascal for Windows or any other Windows programming language that provides access to the Windows functions RegisterMessage, SendMessage, and PostMessage can create their own version of this file.)

CLIPSTAC registers all of these messages with code such as that shown below:

```
  // defined in CSAPI.H
[illegible]
"WM_CLIPSTACREGISTER";
WORD WM_CLIPSTACREGISTER;
.
.
[illegible]
```

Any Windows program can use the same technique to register these messages with Windows. Once you've registered the messages, you can use them to determine whether CLIPSTAC is running and to ask it to perform services for you.

USING THE API To begin using the CLIPSTAC API, your program must first determine whether CLIPSTAC.EXE is running. You can use the WM_CLIPSTACREGISTER message to do this by sending it to all the desktop windows:

```
[illegible]
```

In this code, hWnd is your program's window handle. Because 0xffff is used in place of a target window handle, SendMessage will send this message to all the desktop windows.

If CLIPSTAC is running when you send WM_CLIPSTACREGISTER, CLIPSTAC will save the value of your program's window handle. (The reason it will do so is explained a little later.) CLIPSTAC will reply by posting the same message back to your program, which is why you must supply your program's window handle in wParam, the third parameter. However, CLIPSTAC will supply its *own* window handle as the wParam, so you can save this value and use it again to target the remaining messages to CLIPSTAC itself.

CLIPSTAC will also insert your program's hWnd in the low word of lParam, the fourth parameter. Your program should check to see if these match. If they don't, your program should ignore the WM_CLIPSTACREGISTER message, since it is intended for another program.

The only problem with this scheme is that using 0xffff as SendMessage's first parameter will also send WM_CLIPSTACREGISTER to your own program, with your program's hWnd as a wParam. However, as long as your program ignores all WM_CLIPSTACREGISTER messages in which the high word of lParam is not your program's hWnd, you really shouldn't encounter any problems.

Once you've registered your program with CLIPSTAC, you can use the remaining messages to request

CONTINUES

The CLIPSTAC API

CONTINUED

CLIPSTAC services. For example, you can send WM_CLIPSTACPUSH to CLIPSTAC to copy the current Clipboard contents to the beginning of CLIPSTAC's list. (This is equivalent to the user pressing the CLIPSTAC Paste button.) Or you can send WM_CLIPSTACPOP to copy a specific CLIPSTAC item back into the Clipboard (the equivalent of using CLIPSTAC's Copy button after selecting a specific item). Both messages return TRUE if successful and FALSE if not. Note that while WM_CLIPSTACPUSH does not take any message parameters, WM_CLIPSTACPOP requires that the wParam parameter be set to the index of the CLIPSTAC item you want placed in the Clipboard. CLIPSTAC items are numbered 0. . .*n*, where 0 is the index of the first item in the list. A program can also send the WM_CLIPSTACCOUNT message to retrieve the number of items in CLIPSTAC's list.

Your program can retrieve the identifying information for an item in CLIPSTAC's list—the date, time, format, size, and owner name—via the WM_CLIPSTACGET message. If you send this message to CLIPSTAC you must again supply the index of the item in the wParam parameter. This message's return value is a LPSTR to the item's identifying information (or NULL if the index is invalid or the item cannot be found). You should copy this pointer into a buffer controlled or allocated by your program, and you should not write to the address returned by WM_CLIPSTACGET.

Once your program has obtained this identifying information, it can find the item's current index even if changes to the Clipboard have changed the position of the item in CLIPSTAC's list. All you have to do is send CLIPSTAC a WM_CLIPSTACFIND message with an LPSTR to the identifying information as the last parameter. This message will return the index of the item, or will return with -1 if the item cannot be found. Note that if you pass only part of the information in the LPSTR with this message, CLIPSTAC will return the index of the first item whose information contains the string you passed. Thus, if you only pass the item's owner name, CLIPSTAC will return the index of the first item to have that owner name.

Finally, when your program has finished using CLIPSTAC or is just about to terminate, you should send CLIPSTAC a WM_CLIPSTACDEREGISTER message. This allows CLIPSTAC to remove your program's window handle from its internal list. The reason for registering and deregistering your program with CLIPSTAC—other than to find out if CLIPSTAC is running at all—is so CLIPSTAC can notify your program if the user terminates CLIPSTAC (by selecting Close from the CLIPSTAC System Menu) or ends the Windows session.

Once you've registered your program with CLIPSTAC, you can use the remaining messages to request CLIPSTAC services.

Thus, for example, if CLIPSTAC is about to terminate and your program has registered itself with CLIPSTAC, CLIPSTAC will send your program a WM_CLIPSTACEXIT message. This has the effect of preventing any attempt to continue using CLIPSTAC's services after CLIPSTAC has terminated.

CLIPSTAC's internal list and its maintenance are discussed in the main text of this column.

—Richard Hale Shaw

type from which B is derived (such as the `pointer_to_A_object` pointer) and point it to a B object, calling foo will *also* result in a call to B::foo. Because foo is a virtual function, the appropriate function for a data type is called however it is accessed. You can continue to define new versions of a virtual function in each derived class, and even if you are accessing an object of the class from one of its ancestor classes, only the most-recently derived version is called. That's the advantage of virtual member functions.

In the case of class Window, there is a virtual member function defined for each documented Windows message:

```
class Window
  {
  .
  .
 public:
  virtual void WMNULL(WinAppMsg&);
  virtual void WMCREATE(WinAppMsg&);
  virtual void WMDESTROY(WinAppMsg&);
  virtual void WMMOVE(WinAppMsg&);
  .
  .
  };
```

Each of these virtual member functions is defined so as to call DefWindowProc, the default Windows message handling function. A class derived from class Window—such as class WinDlg or class ClipStac—can define a new version of one of these member functions that overrides the default and does something *other* than call DefWindowProc. If an object doesn't override a virtual function, its ancestor's corresponding function is called. If none of the ancestors have overridden the virtual function, the original, default version is called.

To implement this scheme requires overcoming a couple of difficulties. First, there must be a mechanism, a connecting glue, that ties the window to the C++ class that manages it. (Second, of course, the class Window procedure must be able to use this mechanism.) Two windows, after all, may be managed by classes derived from class Window, and each window may have a different set of overridden virtual member functions. Thus, when the window procedure is called to handle a message for a window managed by a C++ class, the procedure must be able to

call the *appropriate* virtual member function for that window.

Class Window, therefore, creates a connection between a window and the C++ object that manages it. It does this by using the window extra bytes space that you can reserve along with the space occupied by the window itself. (In small data-memory models Windows reserves a 2-byte space; in large data-memory models Windows reserves a 4-byte space.) Class Window stores a pointer to the C++ object that manages the window in these extra bytes.

Initializing the pointer is easy: When class Window calls the CreateWindow API function to create a window, it passes a pointer to the C++ object as the last parameter to that function. This parameter is reserved for use by an application. The class Window window procedure retrieves the pointer during the processing of WM_CREATE or WM_NCCREATE (this last is the second message every window receives) and stores it in the extra bytes. Then class Window can use the pointer to reference the associated C++ object and its virtual member functions.

Although this approach works well enough for associating an object derived from class Window with an ordinary window, it won't work for dialogs—and, therefore, for the modeless dialog used by CLIPSTAC. Since CLIPSTAC's main C++ class, ClipStac, is derived from WinDlg, the latter must supply a similar scheme for storing data in the reserved bytes of a dialog.

WinDlg doesn't call CreateWindow, however. To create a modeless dialog requires a call to CreateDialog, which doesn't offer a way to pass a pointer to the object as part of the creation parameters. So WinDlg temporarily stores the pointer in a global variable from which it is retrieved by the window procedure for WinDlg during the processing of WM_NCCREATE. (A separate window procedure is required because the pointer extraction process for class WinDlg differs from that of class Window.) Since the call to CreateDialog won't return until after WM_CREATE has been processed, the pointer is safely stored in the dialog's extra bytes long before the global variable is reused by WinDlg if another dialog is created.

When you create a modeless dialog, Windows requires that you reserve space for the pointer in the window extra bytes by using the macro DLGWINDOWEXTRA (defined in WINDOWS.H). You can simply add to this value to expand the number of extra bytes reserved and leave room for the pointer. As long as you access only that portion of the extra bytes beyond the reserved area, there's no problem with this approach.

Thus, with a pointer to the window or dialog safely tucked away in the extra bytes, the window procedures for class Window or class WinDlg can extract the pointer and use it to access the appropriate member function when a message is received. Note that both window procedures pass the C++ object pointer and the message to yet another function, StdWndProc. StdWndProc contains a massive C *switch* statement that matches each message to the appropriate virtual member function in class Window. To keep this switch statement small, I've deliberately used compilation controls so as to include only those virtual member functions used by the application. The macros for controlling those member functions are in WINMSG.H.

To enable the handling of the WM_PAINT message by the WMPAINT virtual member function, you define _WM_PAINT in WINMSG.H. You then recompile the files that contain class Window, WINAPP.H, and WINAPP.CPP, which are among the files that comprise CLIPSTAC. Then you need only define a WMPAINT member function in a class derived from class Window to override the default handling of the WM_PAINT message. Note that in the code the only difference between the message name (WM_PAINT), virtual member function name (WMPAINT), and the compilation control macro (_WM_PAINT) is the use of the underscore (_). This is true for all the documented Windows messages.

DYNARRAY, ARRAYMGR, AND FILE CLIPSTAC's primary C++ class, ClipStac, is derived from WinDlg and provides the basic application code for the program. It draws heavily on the functions inherited from class WinDlg and class Window, from the ClipBoard class (see the sidebar "Programming the Clipboard"), and from three other classes: DynArray, ArrayMgr, and File.

The DynArray class is a template class. It uses the C++ templates defined in AT&T C++ 3.0 to implement classes that can work with more than one data type. Because the data types are not hardwired into the class code, DynArray lets you implement dynamic arrays of *any* data type. The DynArray template class definition in Figure 2 is an example.

Using this definition, CLIPSTAC creates a dynamic array of window handles:

```
DynArray<HWND> dynArray;
```

Here, dynArray is an object of class DynArray. CLIPSTAC uses the dynamic array to store the window handles of programs that register themselves with CLIPSTAC for the purpose of accessing the CLIPSTAC API. (See the sidebar "The CLIPSTAC API.") The dynamic array automatically expands or contracts

DYNARRAY
Partial Listing

```
template<class TYPE>
class DynArray
    {
    TYPE   *TArray;
    int size;
    int num;
    void ReSize(int newsize);

public:
    void Init(int n);
    DynArray(int n);
    DynArray(void);
    ~DynArray()                 {   delete[] TArray;    }
    TYPE& operator[](int i)     {   return TArray[i];   }
    NumItems(void)              {   return size;        }
    void Delete(TYPE t);
    void Add(TYPE t);
    };
```

Figure 2: **The DynArray template class definition is used by CLIPSTAC to create an array of window handles.**

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when needed to accommodate the number of window handles stored in it.

CLIPSTAC's File and ArrayMgr classes provide the tools for manipulating the data file, CLIPSTAC.DAT. Actually a small database, this file keeps a copy of every item that CLIPSTAC retrieves from the Clipboard. The first part of the file consists of an array of data structures that contain the Clipboard data format of each item, the item's offset in CLIPSTAC.DAT, and the item's size. Each array element also includes a counter that tracks whether a data item is used more than once in CLIPSTAC's list. The remainder of the file contains a record for every item in CLIPSTAC's list. Each record stores the date and time the item was retrieved from the Clipboard, the Clipboard owner, and the item itself.

When you run CLIPSTAC, it reads the entire array into memory. If a Clipboard item is added, the ArrayMgr class inserts the item at the beginning of the array and moves the other items to the next-higher memory slot. When you delete an item, ArrayMgr closes up the array over the deleted item. Then, when the file is packed, CLIPSTAC retains only the items that are found in the array and discards the others.

The File class simplifies Windows' file handling, providing such functions as Open, ReadAt, WriteAt, and Close. All of these work with 4-byte buffer addresses rather than the 2-byte addresses used by standard C file-handling functions. Class File also hides the details of maintaining a file pointer or file handle. Thus, CLIPSTAC needs only to create an object of class File and use it.

Finally, the ClipStac class uses all of these classes to create the dialog box, initialize the list box from the items stored in CLIPSTAC.DAT, and react appropriately whenever you change the Clipboard's contents.

CLIPSTAC lets you cut and paste as you would in any Windows program, without interfering with your work. While you'll find that larger Clipboard items, such as bitmaps, take slightly longer to manipulate, you should find CLIPSTAC a handy addition to your Windows desktop tools. □

RICHARD HALE SHAW IS A CONTRIBUTING EDITOR TO *PC MAGAZINE*.

LAB NOTES

Accessing the Windows API from the DOS Box, Part 1

BY ANDREW SCHULMAN

Why can't you start a Windows application from Windows' own DOS box? Why should you need a special utility such as WINSTART, by Douglas Boling (Utilities, June 30, 1992)? The answer is that WinExec()—the function that knows how to run Windows programs—is part of the Windows API and, strangely enough, the Windows API is not available to DOS programs running under Windows. The DOS box in Windows *really is* just a box: It seems to have almost no connection with Windows.

Well, then, why *would* you want to run a Windows program from the DOS box or call Windows API functions from a DOS program?

Actually, the very inconvenience and confusion caused by the unavailability of WinExec() in the DOS box shows why the DOS box should be not just *in* Windows, but *of* Windows. The need to remember whether you're in DOS "mode" or Windows "mode," and which kinds of programs you have, and which side of the fence they need to run on, is really part of the old-school way of doing things that Windows supposedly seeks to replace.

An analogy might perhaps be the start of a better answer. As matters stand, it's almost as if Windows were a *very* local area network, with the DOS box running on one machine and the rest of Windows running on another machine. In fact, this is precisely how Windows Enhanced mode is implemented, using a feature of the 80386 that creates a separate *virtual machine* for each DOS box and another for the Windows core. Each "machine" has its own separate address space, and not much communication goes on between them.

But wait a minute. We know that on a network machines *can* still communicate with each other, even though they are separate entities without a shared address space. Likewise, it turns out that there *is* a way to get at some Windows functionality from a plain-vanilla DOS program. Although it often appears otherwise, the DOS box is not completely isolated from the rest of Windows. Windows provides a small set of interrupt-based services to DOS programs, and while far from ideal, these services are sufficient to form a bridge between the DOS box and the rest of Windows.

With an understanding of WINOLDAP and the Clipboard, you can give DOS programs access to Windows functions.

From a programmer's perspective, there are several APIs that Windows provides to DOS programs. The best known is the DOS Protected-Mode Interface (DPMI). Unlike the standard Windows API, which relies on DLLs (dynamic link libraries), DPMI uses software interrupts accessible to DOS programs. Specifically, DPMI uses INT 31h and the *multiplex* interrupt, INT 2Fh. And Windows provides several non-DPMI INT 2Fh functions as well.

This three-part article will discuss a small set of INT 2Fh functions that Windows provides for getting data in and out of the Windows Clipboard from a DOS program. Douglas Boling briefly discussed these functions at the end of his article "DOSCLIP.EXE: A Clipboard for All Sessions" (Utilities, April 14, 1992). In these Lab Notes columns I'll cover them in much greater detail. Part 1 uses these functions to build a DOS library of Windows Clipboard-access functions, and then uses these higher-level functions to create several small DOS-based Clipboard-access utilities.

In the next two issues, I'll show how to build on these functions to access other Windows API functions, including WinExec(). The basic idea is that, while DOS programs can't directly call Windows API functions such as WinExec(), DOS applications can use the Clipboard to pass messages to a Windows program that *can* call the API functions. Under this scheme, the Windows program acts as an agent, server, or surrogate that carries out actions on behalf of its less-capable DOS client. The Windows Clipboard will thus serve as our "transport layer" in this very local area network. The conclusion to this series will consider other, perhaps more suitable "transport layers" whose usefulness lies in the fact that, at a sufficiently low level, DOS boxes and Windows all do share the same memory address space.

This article may seem somewhat odd because, while very much about Windows, it is illustrated primarily with DOS programs. For someone who has been doing Windows programming steadily for some time now, this is a welcome change of pace. It is also one of the best reasons for making the Windows API accessible to DOS programs running under Windows: DOS programs are much easier to write! And, quite frankly, not every

program requires (or deserves) to be rewritten as a Windows application. Yet Windows is—or could be—a fine environment in which to run DOS applications.

BETTER THAN NOTHING The Windows functions we'll be calling from DOS are part of the WINOLDAP.MOD Clipboard API. WINOLDAP is a Windows executable responsible for running "old" (that is, DOS) applications. Actually, it's one of several Windows programs that together perform a complicated, baroque dance to run a DOS application. Other participants include the SHELL virtual device driver (VxD), the Virtual Display Driver (VDD), and the "Grabber."

The WINOLDAP Clipboard API gives DOS programs *programmatic* access to the Windows Clipboard. In other words, instead of waiting for a user to mark, cut, copy, and paste some text from the DOS box screen, your program can directly make WINOLDAP open the Windows Clipboard, get text from it, empty it, put data in it, and close it. The program does this using INT 2Fh, with the AH register set to 17h and with the AL register set to various subfunction numbers, as follows:

```
0h      GetWinOldApVersion()
1h      OpenClipboard()
2h      EmptyClipboard()
3h      SetClipboardData()
4h      GetClipboardDataSize()
5h      GetClipboardData()
8h      CloseClipboard()
9h      CompactClipboard()
0Ah     GetDeviceCapabilities()
```

We'll get to the details about these functions a little later, but here it is important to note that the WINOLDAP Clipboard API is available in Windows Enhanced mode only. This makes sense, because when you run a DOS application in Standard mode, most of Windows is swapped out to disk and is consequently unavailable.

In Enhanced mode, WINOLDAP is actually called WINOA386; it works closely with the SHELL VxD built into WIN386.EXE. (Please note that SHELL VxD must not be confused with SHELL.DLL in Windows 3.1.) When a DOS program issues an INT 2Fh Clipboard API call, the call is originally caught by the SHELL VxD, which uses the Call_Priority_VM_Event function to send the request off to WINOA386. WINOA386 contains a table of functions that carry out requests such as these; for example, it uses the Windows API call OpenClipboard() to satisfy an INT 2Fh AX=1701h.

While these INT 2Fh functions are similar to the "native" Windows Clipboard API calls documented in the *Microsoft Windows Programmer's Reference,* they have been adjusted for the fact that they are being called—through many, many levels of indirection—in a "remote" fashion, almost as if from another machine.

The WINOLDAP Clipboard API is important because it provides the only direct access that a DOS program has to the Windows side of the fence.

For example, the Windows API function SetClipboardData() expects a Windows global memory handle, which is the last thing a DOS program is likely to have. Thus, the implementation for INT 2Fh AX=1703h does all the work of allocating a global memory handle and copying the data into it before calling SetClipboardData(). For bitmaps, it calls CreateBitmap(), another thing a DOS program unfortunately can't do for itself. Also, all pointers in the bitmap data structure have been flattened into actual data.

Likewise, there is no such Windows API function as GetClipboardDataSize(). If a Windows application wants to find the size of an object from the Clipboard, it calls the GlobalSize() function. But since DOS applications don't have direct access to GlobalSize(), WINOA386 provides the GetClipboardDataSize() function. The function's implementation calls GetClipboardData() and then GlobalSize(), thus acting as a surrogate function-caller for the DOS program. In this particular model, it really wouldn't have been too difficult to give DOS programs remote access to the entire Windows API!

The API was fully documented in the Windows 2.*x* SDK (Software Development Kit), but it was omitted from the 3.0 SDK. If you don't happen to have SDK manuals from 1987 sitting in your basement along with back copies of *National Geographic* and *PC Magazine,* you can get full details on the API from a Microsoft KnowledgeBase article, "Access to the Windows Clipboard by DOS Applications" (September 20, 1991; document Q67675). Like all such articles, this one is available from the excellent Microsoft KnowledgeBase on CompuServe (type GO MSKB at the prompt).

Even if you're not particularly interested in the Windows Clipboard as such, the WINOLDAP Clipboard API is still important because it provides the only direct access that a DOS program has to the Windows side of the fence. While intended for the transmission of data such as text and graphics, we can build on the Clipboard API to create a general-purpose "gateway" from the DOS box to the rest of Windows. Once we can move text from a running DOS program into Windows, we can move commands and even make Windows API calls. Limited as it is, the Clipboard API is one of the few ways Microsoft has provided to open Windows from the DOS box.

MAKING THE API LIBRARY Details of the nine functions that make up the WINOLDAP Clipboard API are shown in Figure 1. Unlike the DLL-based Windows API provided to bona fide Windows programs, this Clipboard API expects a software interrupt (INT 2Fh) with parameters in CPU registers.

How do we take the information in Figure 1 and turn it into something that we use in a DOS program? Suppose that we want to open the Windows Clipboard. (You can't do much of anything to the Clipboard without first opening it.) Using assembly language, the information provided for OpenClipboard() in Figure 1 becomes the code shown in Figure 2.

This code assumes, of course, that GetWinOldApVersion() has already been called to determine that the WINOLDAP Clipboard API is available. If it

Windows Clipboard INT 2Fh API

```
GetWinOldApVersion()
    AX = 1700h
  Return:
    AX == 1700h: Clipboard functions not available (Windows not running, or is running in Standard mode)
    AX <> 1700h: AL.AH = WINOLDAP (not Windows!) Version number (Major.minor)
-------------------------------------------------------------------------------
OpenClipboard()
    AX = 1701h
  Return:
    AX <> 0: Success (Clipboard opened)
    AX == 0: Failure (cannot open Clipboard; already opened by another program)
  Note:
    OpenClipboard() does not return a handle to the Clipboard. It is simply an operation that must be performed
    before any other Clipboard-access routines.
-------------------------------------------------------------------------------
EmptyClipboard()
    AX = 1702h
  Return:
    AX <> 0: Success (Clipboard emptied of previous contents)
    AX == 0: Failure
-------------------------------------------------------------------------------
SetClipboardData()
    AX = 1703h
    DX = Clipboard format; WINOLDAP supports the following (CF_ stands for "Clipboard format"):
         CF_TEXT          1
         CF_BITMAP        2
         CF_OEMTEXT       7
         CF_DSPTEXT       81h (owner display)
         CF_DSPBITMAP     82h (owner display)
    ES:BX -> Far pointer to data
    SI:CX = Size of data in bytes (can be > 64k)
  Return:
    AX <> 0: Success (data copied into Clipboard)
    AX == 0: Failure
  Notes:
    (1) The DOS application should call CompactClipboard() (see below) before calling SetClipboardData() to determine
    if there is sufficient memory.
    (2) The bitmap formats mimic the actual Windows bitmap structure, except that instead of including a handle
    or pointer to other memory containing the actual data, the data immediately follows the structure, which thus
    acts as a header prefacing the data.
    (3) Other formats can be exchanged between a DOS application and Windows (even formats produced with
    RegisterClipboard-Format), but these are the ones documented by Microsoft for use by DOS programs.
-------------------------------------------------------------------------------
GetClipboardDataSize()
    AX = 1704h
    DX = Clipboard format (see SetClipboardData(), above)
  Return:
    DX:AX <> 0: Size of the data in bytes, including any headers
    DX:AX == 0: Clipboard does not contain data in the specified format
-------------------------------------------------------------------------------
GetClipboardData()
    AX = 1705h
    DX = Clipboard format (see SetClipboardData(), above)
    ES:BX -> Far pointer to buffer to hold data
  Return:
    AX <> 0: Success; buffer pointed at by ES:BX now contains data
    AX == 0: Failure (for example, Clipboard does not contain data in the specified format)
  Note:
    To determine the size of the buffer pointed to by ES:BX, the DOS program must call GetClipboardDataSize();
    WINOLDAP does not know the size of your buffer. Call GetClipboardDataSize() just before calling
    GetClipboardData().
-------------------------------------------------------------------------------
CloseClipboard()
    AX = 1708h
  Returns:
    AX <> 0: Success
    AX == 0: Failure (could not close Clipboard)
  Note:
    The DOS program must close the Clipboard before exiting, or it will disable Clipboard access for all other programs
    (both DOS and Windows programs).
-------------------------------------------------------------------------------
CompactClipboard()
    AX = 1709h
    SI:CX = Required memory size in bytes
  Returns:
    DX:AX <> 0: Number of bytes in largest block of free memory
    DX:AX == 0: Failure (insufficient memory)
-------------------------------------------------------------------------------
GetDeviceCaps()
    AX = 170Ah
    DX = GDI information index (see WINDOWS.H #defines for GetDeviceCaps(); for example, HORZSIZE = 4 and
    VERTSIZE = 6)
  Returns:
    AX <> 0: Value of desired item
    AX == 0: Error
  Note:
    In the Windows API, GetDeviceCaps() takes an hDC (handle to display context) parameter; from a DOS program,
    the hDC is implied. The device capabilities ("devicecaps") are useful for DOS programs that want to display
    bitmaps.
```

Figure 1: **The nine functions that comprise the Clipboard API give DOS programs interrupt-driven access to Windows.**

isn't (that is, if Windows isn't running, or if it's running only in Standard mode) it isn't even valid to call any of the other functions, including OpenClipboard(). The point here, however, is simply to illustrate how Figure 1 turns into actual code.

The problem with the code shown in Figure 2 is that writing in assembly language is just plain tedious. Even if we were writing in assembly language, we wouldn't want INT 2Fh calls sprinkled all over our code. So, no matter what, we must have a library that makes it easier to call the Windows Clipboard functions from a DOS program.

In a C program, for example, we would want to be able to write code such as this:

```
if (! OpenClipboard())
    return 0;
if (! EmptyClipboard())
{
    CloseClipboard();
    return 0;
}
  etc.
```

To implement such a C-callable function library we need a way to set CPU registers and generate software interrupts. Although these capabilities are not normally found in ANSI-standard C, every C compiler for the PC provides them, as do most other programming languages for the PC (including QuickBASIC and Turbo Pascal).

Until recently, most C programs that needed such capabilities used the `int86()`, `int86x()`, `intdos()`, or `intdosx()` functions from DOS.H. However, both Borland C++ and Microsoft C/C++ provide *inline assembler*. Whereas with a function such as `int86x()` you work with an "image" of the CPU registers, with inline assembler you work with the actual CPU registers. This makes it easy to write efficient C functions that map directly onto low-level API calls.

Three examples—OpenClipboard(), CloseClipboard(), and SetClipboardData()—are shown in Figure 3. These functions are straightforward embodiments of the interface shown in Figure 1, save in three respects. First, OpenClipboard() sets a variable named clip_open,

and CloseClipboard() clears it. The clip_open variable thus holds the current "state" of the Clipboard and is used by another part of the library that will be explained below.

Second, it might be unclear just how SetClipboardData() produces a return value, since it does not contain a C *return* statement. The explanation is that functions compiled by C compilers on the PC return 2-byte quantities in AX and 4-byte quantities in DX:AX. Since the return code from the INT 2Fh call is already in AX, it automatically becomes the function's return value.

Finally, note that SetClipboardData() PUSHes and POPs the SI register. This register may be used by the compiler itself, and since the SetClipboardData() interface dictates that we use it, we must save and restore it. Also note that although SetClipboardData() doesn't use it, the DI register may also be used by the compiler.

The three functions in Figure 3 are excerpted from a larger file, WINCLIP.C. Since the implementation of the other functions—GetClipboardData() and so on—can be extrapolated from the examples provided above, they are not shown here. They are available in WINCLIP.C, however, which can be downloaded from Library 3 (Lab Notes) of the Utilities/Tips Forum on PC MagNet. All the files mentioned in this column can be downloaded from PC MagNet, archived as CLIP1.ZIP. If you don't have a modem, they are also available on-disk by mail. Simply send a postcard with your name, address, and preferred disk size to the attention of Katherine West, Utilities, PC Magazine, One Park Ave., New York, NY 10016. No phone calls, please.

WINCLIP.C assumes it is being called from real mode. If you have a protected-mode DOS program, you can use the DPMI interface or your DOS extender's library to produce a protected-mode version of WINCLIP.C. In fact, I originally wrote WINCLIP.C for Phar Lap's 286|DOS-Extender and 386|DOS-Extender and subsequently ported it to real mode. In general, only functions that manipulate segment registers should require alteration for protected mode; in the case of the INT 2Fh Clipboard API (which is real mode only), that means GetClipboardData() and SetClipboardData().

OPENCLIPBOARD()
Partial Listing

```
mov ax, 1701h           ; OpenClipboard function
int 2fh                 ; call WINOLDAP API
or ax, ax               ; is return 0?
jz failure              ; go somewhere else if it is
; clipboard is now open
```

Figure 2: **This code excerpt shows how to call the OpenClipboard() function from assembly language.**

WINCLIP.C
Partial Listing

```
unsigned OpenClipboard(void)
{
    unsigned retval;
    _asm mov ax, 1701h
    _asm int 2fh
    _asm mov retval, ax
    if (retval) clip_open++;  /* see text for explanation */
    return retval;
}

unsigned CloseClipboard(void)
{
    unsigned retval;
    _asm mov ax, 1708h
    _asm int 2fh
    _asm mov retval, ax
    if (retval) clip_open--;  /* see text for explanation */
    Yield();    /* this is a good place to Yield */
    return retval;
}

unsigned SetClipboardData(CF_FORMAT format, unsigned char far *buf,
    unsigned long len)
{
    _asm push si                    /* save away SI; compiler may use it */
    _asm mov ax, 1703h              /* SetClipboardData */
    _asm mov dx, format             /* CF_ format */
    _asm les bx, buf                /* far pointer to buffer */
    _asm mov si, word ptr len+2     /* HIWORD of length */
    _asm mov cx, word ptr len       /* LOWORD of length */
    _asm int 2fh                    /* call WINOLDAP API */
    _asm pop si                     /* restore saved SI */
    /* return value in AX (0 if failure) */
}
```

Figure 3: **C functions for OpenClipboard(), CloseClipboard(), and SetClipboardData(), excerpted from WINCLIP.C.**

To illustrate the necessary changes, a version of SetClipboardData() for 286|DOS-Extender is shown in Figure 4. It uses the Phar Lap API (PHAPI) function DosAllocRealSeg() to allocate conventional memory and the function DosRealIntr() to generate a real-mode interrupt. It is instructive to compare this with the real-mode version of the SetClipboardData() function in Figure 3. Whereas the real-mode SetClipboardData() just stuffs values into registers and makes the INT 2Fh call, the protected-mode version has to jump through a good many hoops in order to access the real-mode API. Specifically, the protected-mode version has to allocate a conventional-memory buffer, copy down into it from protected mode, and then pass a real-mode paragraph address to it.

When we're finished with coding an interface to the API, we need an include file that can be used by programs that want to use the API. WINCLIP.H is shown in Figure 5.

HIGHER-LEVEL SERVICES So far, we've built a C interface library for the Clipboard API; its definitions are in WINCLIP.H and the implementation is in WINCLIP.C. The next step, of course, is to write a sample program to test out the library. (Actually, we should have written the test program first and then produced an interface library that satisfies it, but I've decided to take a more bottom-up approach here.)

SETCLIPBOARDDATA()
Partial Listing

```
unsigned SetClipboardData(CF_FORMAT format, unsigned char far *buf,
    unsigned long len)
{
    REGS16 r;
    unsigned char far *rbuf;
    USHORT seg;
    SEL sel;

    /* allocate conventional memory; get its real-mode paragraph
     address in seg, and its equivalent protected-mode selector
     in sel */
    if (DosAllocRealSeg(len, &seg, &sel) != 0)
        return 0;
    rbuf = MAKEP(sel, 0);
    _fmemcpy(rbuf, buf, (size_t) len); /* use protected-mode selector */

    memset(&r, 0, sizeof(r));
    r.ax = 0x1703;
    r.dx = format;
    r.es = seg;          /* use real-mode paragraph address */
    r.bx = 0;
    r.si = len >> 16;
    r.cx = len & 0xFFFF;
    DosRealIntr(0x2f, &r, 0, 0);
    DosFreeSeg(sel);
    return r.ax;         /* 0 if failure */
}
```

Figure 4: This protected-mode version of SetClipboardData() is written for the 286|DOS-Extender.

TESTCLIP.C, which is shown in Figure 6, is a normal, real-mode DOS program that retrieves text from the Windows Clipboard. It can be compiled with Borland C++, Version 3.0, or Microsoft C, Version 6.0. The program uses plain old `printf()` from the C standard library to display text on `stdout` (DOS standard output); this can be redirected to a file. To get text from the Windows Clipboard, TESTCLIP.C performs the operations of:

- Calling IdentifyWinOldApVersion() to ensure that Windows Enhanced mode is running and that WINOLDAP is available;
- Calling OpenClipboard() to claim temporary ownership of the Clipboard;
- Calling GetClipboardDataSize(CF_TEXT) to find out how many bytes of text (if any) there are;
- Allocating memory to hold the text;
- Calling GetClipboardData() to retrieve it; and
- Calling CloseClipboard() to relinquish ownership of the Clipboard.

You can ensure that TESTCLIP does its job by cutting a file to the Windows Clipboard and then running TESTCLIP with its output redirected to a file. The two files should be identical, save perhaps for an extra newline at the end of the redirected file, which is caused by the `Cputs()` function.

In fact, you'll find that it's sometimes a lot easier to pull text out of the Windows Clipboard with TESTCLIP than it is to use a full-blown Windows program. More important, however, is the fact that TESTCLIP also reveals several big problems with the WINOLDAP Clipboard API.

First, there's big trouble if a DOS program succeeds in opening the Windows Clipboard but dies or crashes or exits without closing it. Neither another DOS program nor even a Windows program will be able to access the Clipboard. The only solution is to exit Windows and restart it. And since a DOS application can be terminated simply by hitting Ctrl-C, we need to do something to ensure that the Clipboard gets closed *no matter what.*

TESTCLIP.C does all it can to make sure that it calls CloseClipboard() before exiting. That's the purpose of the clip_open variable. Note, too, that the program calls CloseClipboard() before printing the string with `printf`. That's the point at which the user is most likely to hit Ctrl-C, and in any case we don't need to keep the Clipboard open after we've retrieved the text. Also note that unless you have BREAK=ON, the Ctrl-

WINCLIP.H
Complete Listing

```
/*
WINCLIP.H -- DOS access to Windows Clipboard (Enhanced mode)

Copyright (c) 1992 Ziff Davis Communications
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*/

#ifdef METAWARE
/* if using with 32-bit code */
#define far _far
#endif

#ifdef __cplusplus
extern "C" {
#endif

/* higher-level functions */

int WindowsClipboard(void);
int Clipserv(void);
int PutClipStrLen(char *str, unsigned len);
int PutClipString(char *str);
char *GetClipString(void);
void FreeClipString(char *str);

/* lower-level functions */

#define CF_TEXT             1
#define CF_BITMAP           2
#define CF_DSPTEXT          0x81
#define CF_DSPBITMAP        0x82

typedef unsigned short CF_FORMAT;

unsigned long CompactClipboard(unsigned long size);
unsigned CloseClipboard(void);
unsigned EmptyClipboard(void);
unsigned char far *GetClipboardData(CF_FORMAT format,
    unsigned char far *buf);
unsigned long GetClipboardDataSize(CF_FORMAT format);
unsigned GetDeviceCaps(unsigned index);
unsigned IdentifyWinOldApVersion(void);
unsigned OpenClipboard(void);
unsigned SetClipboardData(CF_FORMAT format, unsigned char far *buf,
    unsigned long size);
void Yield(void);

#ifdef __cplusplus
}
#endif
```

Figure 5: WINCLIP.H is the include file for use with WINCLIP.

TESTCLIP.C

Complete Listing

```
/*
TESTCLIP.C -- throw-away test program for Windows clipboard API

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*/

#include <stdlib.h>
#include <stdio.h>
#include <malloc.h>
#include "winclip.h"

static int clip_open = 0;

void fail(char *s)
{
    if (clip_open)
        CloseClipboard();
    puts(s);
    exit(1);
}

main()
{
    unsigned long len;
    char far *buf;

    if (! IdentifyWinOldApVersion())
        fail("This program must run in a DOS box "
             "under Enhanced mode Windows");

    /* MUST do OpenClipboard before GetClipboardDataSize */
    if (! OpenClipboard())
        fail("Can't open clipboard -- try again later");
    clip_open = 1;

    if ((len = GetClipboardDataSize(CF_TEXT)) == 0)
        fail("No text in clipboard");

    /* printf("%lu bytes of text in clipboard\n", len); */

    /* the following can be removed in 32-bit code */
    if (len > 0xFFF0UL)
        fail("Sorry, can't handle more than 64k of text");

    if ((buf = _fmalloc(len+1)) == 0) /* add 1 for NULL terminate */
        fail("Insufficient memory");

    if (! GetClipboardData(CF_TEXT, buf))
        fail("Couldn't get clipboard text");

    /* finally, we've got our text */
    CloseClipboard();       /* close it BEFORE displaying string */
    buf[len] = '\0';        /* add NULL terminate */
    printf("%Fs\n", buf);   /* print FAR string */
    return 0;
}
```

Figure 6: TESTCLIP.C is a DOS program that retrieves text from the Windows Clipboard.

Break won't be processed *until* the I/O operation that prints the string. So, if the user closes up before `printf`, he's in relatively good shape.

These measures are not fully adequate, however, and they shouldn't have to be thought about anyway. The Clipboard-access library should take care of such details instead of forcing applications such as TESTCLIP to worry about them.

A second and bigger problem TESTCLIP reveals is that our Clipboard-access library is too low-level. All we really want are functions that make it possible to put text onto and get text out of the Windows Clipboard. These functions are described in Figure 7. Once we implement these higher-level functions we should be able to totally forget about the low-level details of opening the Clipboard, making sure it gets closed, getting its size if we're retrieving text, and so on. (Note that the functions could be extended to the non-text bitmap format that the WINOLDAP Clipboard API supports, of course.)

HIGH-LEVEL ACCESS FUNCTIONS

Partial Listing

```
/* is the clipboard available? */
int WindowsClipboard(void);

/* put "len" bytes of text on clipboard */
int PutClipStrLen(char *str, unsigned len);

/* put NULL-terminated text on clipboard */
int PutClipString(char *str);

/* get text from clipboard */
char *GetClipString(void);

/* free the retrieved text when done */
void FreeClipString(char *str);
```

Figure 7: These are some of the desirable higher-level Clipboard-access functions.

The resulting higher-level functions are shown in Figure 8. The function GetClipString() is really just our TESTCLIP program, now turned into a function. Note that GetClipString() takes care of allocating memory for the retrieved text. This memory can be freed with the (utterly simple) FreeClipString() function.

The discussion so far has centered on retrieving the Clipboard contents. The function PutClipStrLen() ties together everything needed to *change* the Windows Clipboard from a DOS program. Note that the Clipboard must be emptied and compacted before changing it.

Most important of all, the routines in Figure 8 include clip_init(), which installs an `atexit()` handler and a Ctrl-C handler. I used a C static variable, winoldap, to ensure that clip_init() gets called once and only once. The `atexit()` handler, called exit_func(), and the Ctrl-C handler, called sigint_handler(), simply call CloseClipboard() if clip_open is still TRUE. There's nothing terrifically exciting about this, but putting it all inside WINCLIP.C means that we never have to think about it again.

SOME SIMPLE UTILITIES With our high-level Clipboard-access library, it now takes only a few lines of code to add some useful DOS/Windows hybrid utilities. (Such hybrids are DOS programs that require Windows to run.)

Figure 9 shows the program GETCLIP.C. It is similar to the earlier TESTCLIP program, but it uses the higher-level functions. In fact, at around 30 lines of code, it's really just a wrapper around the GetClipString() function.

PUTCLIP.C (shown in Figure 10) is more interesting, not only because changing things is intrinsically more interesting than just looking at them, but because there are a number of possible places from which PUTCLIP can get its input. Running

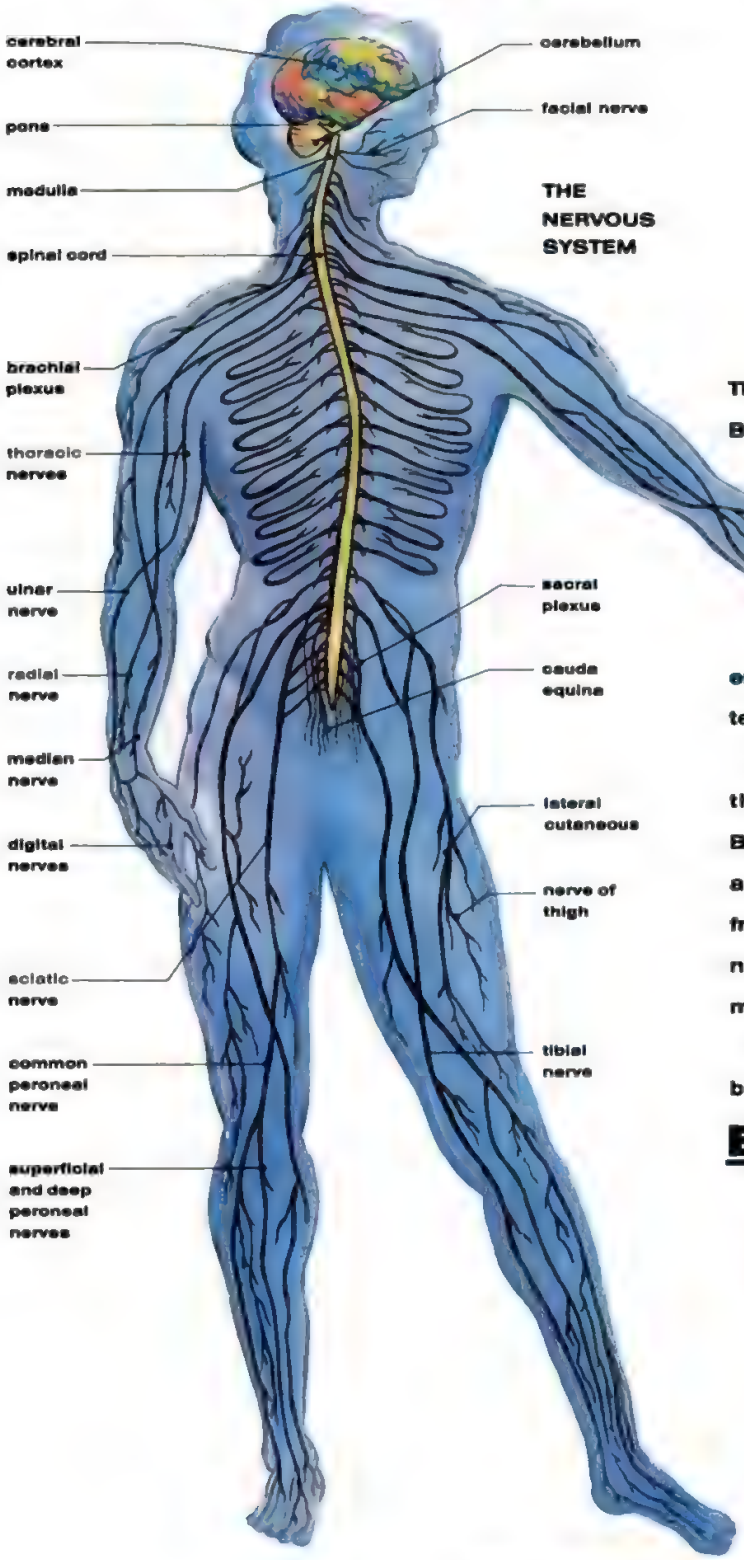
```
PUTCLIP "HelloWorld"
```

will, it should come as no surprise, put "Hello World" on the Windows Clipboard. The command

```
PUTCLIP @filename.ext
```

puts an entire file (up to 32K in length) on the Clipboard. Entering

A BAD DISK CAN DO SERIOUS DAMAGE TO YOUR SYSTEM.



There are two types of computer disks. Bad disks. And good disks.

And here's the problem: bad disks don't tell you they're bad until it's far too late. Suddenly your computer says you're experiencing a "fatal disk error." (Your body has a different term for it. Like panic.)

Fortunately, good disks can tell you they're good. They will simply say BASF right on the package. And they come from the people who not only invented magnetic recording, they perfected it.

The next time you're buying disks, be safe. BASF.

BE SAFE. BASF.

BASF

CIRCLE 130 ON READER SERVICE CARD

WINCLIP.C

Partial Listing

```
/*
WINCLIP.C -- DOS access to Windows Clipboard (Enhanced mode)

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*/

#include <stdlib.h>
#include <string.h>
#include <malloc.h>
#include <signal.h>
#include <dos.h>
#include "winclip.h"

static int winoldap = 0;
static int clip_open = 0;

static int clip_init(void);

/* higher-level functions */

int WindowsClipboard(void)
{
    return (IdentifyWinOldApVersion() != 0);
}

/* NOTE: len should include NULL-termination byte,
   which is required */
int PutClipStrLen(char *s, unsigned len)
{
    if (! winoldap)
        if (! clip_init())
            return 0;

    if (! OpenClipboard())      /* does clip_open++ */
        return 0;
    if (! EmptyClipboard())
    {
        CloseClipboard();       /* does clip_open-- */
        return 0;               /* couldn't empty */
    }
    if (CompactClipboard(len) < len)
    {
        CloseClipboard();
        return 0;               /* couldn't compact */
    }
    if (! SetClipboardData(CF_TEXT, s, len))
    {
        CloseClipboard();
        return 0;               /* couldn't set */
    }
    CloseClipboard();
    Yield();
    return 1;
}

int PutClipString(char *str)
{
    return PutClipStrLen(str, strlen(str)+1);
}

char *GetClipString(void)
{
    unsigned long len;
    char *s;

    if (! winoldap)
        if (! clip_init())
            return (char *) 0;

    if (! OpenClipboard())
        return (char *) 0;
    /* MUST do OpenClipboard BEFORE GetClipboardDataSize */
    if ((len = GetClipboardDataSize(CF_TEXT)) == 0)
    {
        CloseClipboard();
        return (char *) 0;      /* nothing there */
    }
    if (len > (0xFFFFU - 16))
    {
        CloseClipboard();
        return (char *) 0;      /* too big */
    }
    if ((s = (char *) calloc((unsigned) len+1, 1)) == NULL)
    {
        CloseClipboard();
        return (char *) 0;      /* insufficient memory */
    }
    if (! GetClipboardData(CF_TEXT, s))
    {
        CloseClipboard();
        return (char *) 0;      /* couldn't get it */
    }
    CloseClipboard();
    Yield();
    return s;
}

void FreeClipString(char *s)
{
    free(s);
}

/* lower-level functions */ .

void sigint_handler(int sig)
{
    if (clip_open != 0)
        CloseClipboard();
    exit(1);
}

void exit_func(void)
{
    if (clip_open != 0)
        CloseClipboard();
}

static int clip_init(void)
{
    if (winoldap)
        return 1;   /* already did init */

    if (! (winoldap = IdentifyWinOldApVersion()))
        return 0;

    /* install handlers so that we never exit holding
       the clipboard open */
    atexit(exit_func);              /* at-exit handler */
    signal(SIGINT, sigint_handler); /* Ctrl-C handler */
    return 1;
}

/* other lower-level functions are here; see WINCLIP.C */
```

Figure 8: This section of WINCLIP.C implements the higher-level functions described in Figure 7.

```
PUTCLIP -
```

puts its standard input on the Clipboard so that, for example, the command

```
DIR | PUTCLIP -
```

puts a DOS directory listing on the Windows Clipboard. Apart from handling these variants, though, PUTCLIP is just packaging for the function PutClipStrLen().

Earlier, when checking that TESTCLIP worked, it required a somewhat cumbersome process (go into Notepad, select the whole file, select Edit Copy) to get a file onto the Windows Clipboard. Now that we have PUTCLIP, it's easy to test that everything works. Just enter:

```
PUTCLIP @putclip.c
GETCLIP | diff test.txt -
```

This should produce no output, which indicates that GETCLIP gets exactly what PUTCLIP puts. The program diff is an almost indispensable utility. Originally from Unix, it is now widely available on the PC. The program compares two files or, in this case, a file with `stdin`. You could, however, use a DOS compare program such as COMP or FC instead. To test using FC, you would enter:

```
PUTCLIP @filename.ext
GETCLIP > filename.new
FC filename.ext filename.new /W
```

The /W switch tells FC to compress white space (spaces, tabs, blank lines) for the comparison. Why does PUTCLIP limit itself to a maximum of 32K of text? Since

GETCLIP.C

Complete Listing

```
/*
GETCLIP.C -- DOS program gets text from Windows clipboard
requires WINCLIP.C
for example (Borland C++): bcc getclip.c winclip.c

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PC Magazine * Andrew Schulman (June 1992)
*/

#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "winclip.h"

void fail(char *s) { fputs(s, stderr); fputs("\n", stderr); exit(1); }

int main(int argc, char *argv[])
{
    char *s;

    fputs("GETCLIP version 1.0\n", stderr);
    fputs("Copyright (c) 1992 Ziff Davis Communications *
          "* Andrew Schulman\n\n", stderr);

    if ((argc > 1) && (argv[1][0]=='/') && (argv[1][1]=='?')) // /?
        fail("GETCLIP retrieves text from the Windows clipboard");

    if (! WindowsClipboard())
        fail("This program must run in a DOS box *
             "under Enhanced mode Windows");

    if (s = GetClipString())
    {
        puts(s);
        FreeClipString(s);
    }
    else
        puts("* clipboard empty *");
    return 0;
}
```

Figure 9: **GETCLIP.C is a DOS utility that retrieves text from the Windows Clipboard.**

PUTCLIP.C

Complete Listing

```
/*
PUTCLIP.C -- put text onto Windows clipboard
requires WINCLIP.C
for example (Borland C++): bcc putclip.c winclip.c

Copyright (c) 1992 Ziff Davis Communications
PC Magazine * Andrew Schulman (June 1992)
*/

#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <dos.h>
#include <io.h>
#include <fcntl.h>
#include "winclip.h"

void fail(char *s) { puts(s); exit(1); }

int main(int argc, char *argv[])
{
    unsigned len;
    char *p;

    fputs("PUTCLIP version 1.0\n", stderr);
    fputs("Copyright (c) 1992 Ziff Davis Communications *
          "* Andrew Schulman\n\n", stderr);

    if ((argc < 2) ||
        ((argc > 1) && (argv[1][0]=='/') && (argv[1][1]=='?'))) // /?
        fail(
    "PUTCLIP puts text onto the Windows clipboard\n"
    "usage: PUTCLIP :text        puts text into clipboard\n"
    "       PUTCLIP @filename    puts file contents into clipboard\n"
    "       PUTCLIP -            copies standard input into clipboard\n");

    if (! WindowsClipboard())
         fail("This program must run in a DOS box *
              "under Enhanced mode Windows");

    if (! (argv[1][0] == '-' || argv[1][0] == '@'))
    {
         /* Put string from command line onto clipboard */
         static char buf[128];
         char far *cmdline = MK_FP(_psp, 0x82);
         int len = *((unsigned char far *) MK_FP(_psp, 0x80)) - 1;
         _fmemcpy(buf, cmdline, len);
         p=buf;
    }
    else
    {
         int f;
         unsigned rc;    /* count of bytes read */
         if (argv[1][0] == '-' && argv[1][1] == '\0')  // - on cmdline
              f = 0;       // STDIN
         else if (argv[1][0] == '@')   // filename on cmdline
              if ((f = open(&argv[1][1], O_RDONLY)) == -1)
                   fail("can't open file");
         if ((len = filelength(f)) > (32 * 1024))// 32k max
              fail("file too big");
         if ((p = malloc(len+1)) == 0)
              fail("insufficient memory");
         if ((rc = read(f, p, len)) < 1) // means 32k max!
              fail("can't read file");
         close(f);
         p[rc] = '\0';   /* must be NULL terminated */
         len = rc;
    }

    if (PutClipStrLen(p, len+1))   // +1 for NULL
        puts("putclip successful");
    else
        puts("putclip failed");

    return 0;
}
```

Figure 10: **PUTCLIP.C is a DOS utility that puts text into the Windows Clipboard.**

the GetClipboardDataSize() function expects a 4-byte number, you would think we could move megabytes at a time onto the Clipboard. In fact, a 32-bit 386|DOS-Extender version of PUTCLIP was able to do just that, and the 32-bit version of GETCLIP retrieved them without a hitch. But I found that Windows utilities such as the Clipboard Viewer got hopelessly confused by such large items.

Why do PUTCLIP and GETCLIP limit themselves to text? After all, the WINOLDAP Clipboard API also supports bitmaps. This, in fact, is probably why the API provides the seemingly out-of-place GetDeviceCaps() function—so that DOS programs can properly display bitmaps retrieved from the Clipboard. You may want to try to modify PUTCLIP and GETCLIP to handle bitmaps.

However, the purpose of our work so far has been to prepare for sending *requests* to Windows. These requests (or commands) will look just like text, but will be interpreted by a Windows program waiting patiently for them to appear in the Clipboard. How to write such a Windows program, and then how to write DOS programs that send the requests, will be discussed in Parts 2 and 3. When we're done, we'll have knocked down some of the walls around the DOS box. □

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ENVIRONMENTS

Buffered Input and Output Of MIDI Short Messages

BY CHARLES PETZOLD

As you'll recall, in the previous issue I complained about an apparent gap I perceived in the application programming interface (API) of Microsoft Windows with Multimedia Extensions: a gap in the support of the Musical Instrument Digital Interface (MIDI). I felt that the low-level API should have included functions for buffered input and output of MIDI short messages.

MIDI short messages are 1, 2, or 3 bytes in length. A MIDI controller (such as a keyboard) generates MIDI short messages when you press and release keys or when you manipulate dials or buttons on the keyboard. A MIDI synthesizer responds to the MIDI short messages by sounding tones. It would be nice to write a program that stores messages coming from a controller through the MIDI In port of a MIDI board and later plays them back through an internal synthesizer or an external one connected to the MIDI Out port of the board.

Currently you can use the low-level API to send and receive MIDI short messages only one at a time, either in a window procedure or a DLL (dynamic link library). It's most convenient to use a window procedure, of course, but then you don't get time stamps for MIDI input and you're forced to use the imprecise Windows timer for MIDI output.

For the degree of accuracy that music requires, you need to use a DLL. A callback function in the DLL can obtain MIDI messages from a keyboard or other controller with time stamps accurate to a millisecond. With a DLL, you can also use the high-precision multimedia timer for sending MIDI messages to a synthesizer, also with millisecond accuracy.

That you need to use a DLL to work with the low-level MIDI API really bothers me. First, there is the nuisance of separating program code into an executable and a DLL. Furthermore, the DLL must include functions that are called by the system during hardware interrupts, and these functions can be tricky to write.

EXTENDING THE API It would be most convenient to send and receive MIDI short messages using a buffer. For example, you could submit a buffer to the API to get MIDI input messages from a controller. This buffer, which would contain both the MIDI messages and timing information, could be returned to the program when full. You could then submit the buffer to the API to play the messages on a MIDI synthesizer. Because the API would handle all the timing, you wouldn't need to use a DLL. You could do everything from a window procedure.

Windows wouldn't be Windows if you couldn't extend the API. So I decided to define several new functions for buffered MIDI input and output.

Of course, Windows wouldn't be Windows if there weren't a way to extend the API. So I decided to correct the deficiency in the MIDI API by defining several new functions for buffered MIDI input and output. I had to use a dynamic link library for this, of course, but it's a DLL that can be used by several different types of MIDI programs. The DLL is responsible for implementing the callback functions that obtain MIDI input messages and use the multimedia timer for sending MIDI output messages.

Fortunately, some models for the new functions I had to invent already existed. The waveform audio API in Multimedia Windows uses buffers for both input and output, and even the MIDI API includes some functions for buffered input and output—albeit useful only for MIDI long (system-exclusive) messages.

I set a couple goals for myself: The new functions should look and work very much like existing API function calls, and the DLL should be written so that programmers could integrate the new functions into an existing program without having to make a slew of changes. Moreover, these new functions should not interfere with the existing API.

A NEW MIDI INPUT FUNCTION I began by defining the functions I thought should be added to the low-level MIDI API. The first was:

```
midiInShortBuffer (hMidiIn,
  lpMidiHdr, sizeof (MIDIHDR))
```

The word *short* in this function name does not refer to the length of the buffer, but indicates that the function is used for submitting a buffer to receive MIDI short messages. The function has the same syntax as midiInAddBuffer, which is used for submitting a buffer to obtain the long system-exclusive messages.

The first parameter is a handle to a MIDI input device; the second parameter is a pointer to a MIDIHDR structure. In this MIDIHDR structure, the lpData field must be set to a pointer to a buffer, and the dwBufferLength field must be set

to the size of this buffer. The buffer must be at least 8 bytes long, and preferably the size should be a multiple of 8 bytes.

As usual, both the MIDIHDR structure and the buffer must be allocated from global memory using the GMEM_MOVEABLE and GMEM_SHARE flags. Before calling midiInShortBuffer, the MIDIHDR structure must be passed to the midiInPrepareHeader function. This locks the structure and buffer in memory and prevents Windows from swapping them to disk.

Following a call to midiInShortBuffer, all short messages coming through the MIDI In port are accumulated in the buffer. (The single exception is the Active Sensing message that many MIDI controllers send out to indicate they are still connected.) The buffer is returned to the application when the buffer is full or when midiInReset is called. A buffer is returned to an application using the MM_MIM_LONGDATA message to a window procedure or an MIM_LONGDATA message to a callback function. These are the same messages used to return buffers submitted using the midiInAddBuffer call. (If a program is also using midiInAddBuffer to receive system-exclusive messages, it is the responsibility of the application to determine which is which.)

When the buffer is returned to the application, the dwBytesRecorded field of the MIDIHDR structure indicates how much data is in the buffer. This will always be a multiple of 8 bytes. The data in the buffer consists of a series of 32-bit unsigned integers, alternating between delta times (in milliseconds) and MIDI short messages packed into 32-bit integers. The first delta time is measured from the time midiInStart was called. Subsequent delta times indicate the millisecond delays between successive MIDI messages.

You can submit multiple buffers using midiInShortBuffer before the first buffer is returned. In fact, this is recommended so that you don't lose any messages between the time you get back one buffer and the time you submit another. The buffers can be larger than 64K.

NEW MIDI OUTPUT FUNCTIONS My next task was to define a similar function for MIDI output:

```
midiOutShortBuffer (hMidiOut,
  lpMidiHdr, sizeof (MIDIHDR))
```

This function works the same way as midiOutLongMsg. The format of the buffer is as described above, with alternating 32-bit delta times and 32-bit packed MIDI messages. The function plays the MIDI messages in the background until the buffer is finished or until midiOutReset is called. The function indicates that the buffer is finished by sending an MM_MOM_DONE message to a window procedure or making an MOM_DONE call to a callback function in a DLL. This is the same message used for indicating that buffers submitted with midiOutLongMsg are finished. Multiple buffers can be submitted before the first buffer has been returned, and the buffers can be larger than 64K.

You won't lose any messages between the time you get back one buffer and the time you submit another if you use midiInShortBuffer to submit multiple buffers.

At this point, two additional functions become feasible, one to pause MIDI output

```
midiOutPause (hMidiOut)
```

and another to restart it:

```
midiOutRestart (hMidiOut)
```

These functions were inspired by waveOutPause and waveOutRestart, which are used for waveform audio output.

SMOOTH INTEGRATION As I thought about implementing these new functions in a DLL, it became obvious that the DLL would also have to include enhanced versions of some of the existing MIDI function calls. Some functions (such as midiOutPrepareHeader) didn't need to be tampered with. Others required additional functionality. For example, midiOutReset has to mark all pending short-message buffers as done and return them to the application. So midiOutReset had to be made to do what it does normally, and then perform additional work as well.

Of course, this new midiOutReset function must be able to identify the buffers associated with the handle to the MIDI output device. If only one program were allowed to use the DLL, this information could be stored in static variables in the DLL. But that didn't seem good enough. It would be preferable to allow two or more programs to use the DLL simultaneously with different MIDI ports.

This implied that all the information needed to implement the four new function calls had to be stored in the DLL's local heap space, probably as a small structure. A pointer to this structure would have to be identified by the handle passed as a first parameter to the MIDI functions. Thus, I couldn't use the real MIDI input or output handle in these functions. The handle had to be a pointer into the DLL's local heap. One field of the structure stored there would be the real handle to the MIDI device.

This meant that my DLL would have to include new versions of all the MIDI input and output functions that referred to the handle to the MIDI device. The new midiInOpen and midiOutOpen functions would call the existing open functions to obtain a MIDI input and output handle, allocate some memory in the DLL local heap for a data structure, store the real handle there, perform some initialization, and then pass back to the application the pointer to the DLL heap. The new midiInClose and midiOutClose functions would call the existing close functions and also free the local memory.

To the application, nothing would appear different. The application would still call the same MIDI functions, but they would be intercepted by the new DLL.

FUNCTION NAMES AND DLLs Of course, there's a little problem here. How do you define a function named midiInOpen in a new DLL when this function must call a function named midiInOpen in another DLL? It's not really as difficult as it may seem at first, just a little confusing.

Before I dive in, some background:

When you write a Windows program, you make calls to Windows functions such as midiInOpen. Of course, what you're implicitly doing is calling a particular function in a particular DLL, in this case MMSYSTEM.DLL. This crucial information is inserted into the program's .EXE file during linking. For a Windows program using multimedia function calls, you must link with the MMSYSTEM.LIB import library. This import library indicates that a call to a function named midiInOpen is really a call to a function in MMSYSTEM.DLL named midiInOpen with an ordinal number of 304.

The object here is to create a new DLL (let's call it MIDBUF.DLL) that exports functions named midiInOpen, and so forth. This DLL makes calls to midiInOpen and other functions in MMSYSTEM.DLL. An import library named MIDBUF.LIB could also be created. This import library would indicate that the function named midiInOpen is actually a call to MIDBUF.DLL. If you write an application and want to use the MIDBUF dynamic link library, you link with both MIDBUF.LIB and MMSYSTEM.LIB. On the link command line, MIDBUF.LIB must appear before MMSYSTEM.LIB.

What happens is that the application's .EXE file is set up so that the midiInOpen call is actually a call to the midiInOpen function in MIDBUF.DLL. The midiInOpen function in MIDBUF.DLL then makes a call to the midiInOpen function in MMSYSTEM.DLL.

The mechanics are simpler than you may think. In the MIDBUF.C source code file, the functions you want to intercept are given different names; for example, xMidiInOpen. This function can then make a call to the real midiInOpen function without the compiler thinking you're making recursive calls.

In the module definition file, you define xMidiInOpen as an alias in the EXPORTS section of the module definition file:

```
EXPORTS
    midiInOpen = xMidiInOpen
```

The function actually exported from the DLL is called midiInOpen, but this function is the same as xMidiInOpen in the C source code file. When you create the MIDBUF.LIB import library from the module definition file, the xMidiInOpen alias is ignored and the function appears in the import library as midiInOpen.

AND NOW THE IMPLEMENTATION The source code for the MIDBUF DLL grew to be a little larger than I expected, so it won't be printed here. The files, which include MIDBUF.MSC and MIDBUF.BCP (Make files for Microsoft C/C++ 7.0 and Borland C++ 3.0, respectively), MIDBUF.C, MIDBUF.DEF, and the dynamic link library MIDBUF.DLL, can be downloaded from PC MagNet and are archived as MIDBUF.ZIP. If you want to use the DLL in an application, you'll need two other files, also included in MIDBUF.ZIP: MIDBUF.H, a header file that defines the four new functions, and the import library MIDBUF.LIB.

The new midiInOpen function in MIDBUF first allocates memory in the DLL's local heap for a small data structure. Normally, when you open a MIDI input device, you specify in the midiInOpen function whether you want to be notified of MIDI messages through a window procedure or a callback function in a DLL. You can also specify application-defined data that is passed to the callback function.

Specify in midiInOpen whether you want to be notified of MIDI messages through a window procedure or a callback function.

The new midiInOpen function stores this information in the data structure that was just allocated. The new function then calls the old midiInOpen function, always specifying a callback function in MIDBUF.DLL. The application-defined data field in the open call is set to the data structure pointer. If the midiInOpen call is successful, the input and output handle is also stored in the data structure, and the pointer to the data structure is passed back to the application.

In subsequent MIDI input calls, the handle is passed as the first parameter to the function. The functions in MIDBUF.DLL use this handle as a pointer into the local heap, and thus can easily retrieve the real MIDI input handle. The callback function also has access to this data structure, and can then post a message to the application's window procedure or call another callback function, depending on what the application requested.

When buffers are passed to the new midiInShortBuffer function, they are maintained as a linked list. If you take a look at the definition of the MIDIHDR structure in the *Microsoft Windows Multimedia Programmer's Reference*, you'll see a field called lpNext, which is defined as a far pointer to a MIDIHDR structure. The documentation cautions that this structure field is "reserved and should not be used," but it's obvious that its purpose is for linking buffers.

In the MIDI input callback function in MIDBUF.DLL, incoming MIDI messages are indicated by an MIM_DATA call. These MIDI messages are stored in the current buffer. When the buffer becomes full, the callback function notifies the application through the use of an MM_MIM_LONGDATA message posted to a window procedure, or through an MIM_LONGDATA call to the application-requested callback function.

For buffered MIDI output, MIDBUF.DLL needs to use the multimedia timer routines to set a high-precision timer. This timer also requires a callback function in the DLL. For the first buffer submitted to midiOutShortBuffer, timeSetEvent is called using the first delta time in the buffer. During the timer callback function, the MIDI message is sent to the device using midiOutShortMessage. The timeSetEvent function is then called again with the next delta time. When the buffer is finished, the application is notified through the use of an MM_MOM_DONE message posted to a window procedure or an MOM_DONE call to the application-requested callback function.

LET'S TRY IT OUT In the next issue, I'll present a program called MIDREC that uses MIDBUF to record MIDI messages coming from a keyboard or other MIDI controller and then plays them through a MIDI synthesizer. □

POWER PROGRAMMING

The Windows 3.1 ToolHelp DLL, Part 1

BY RAY DUNCAN

At the inception of its "Blue Ninja" marketing campaign, IBM touted OS/2, Version 2.0, as "a better DOS than DOS, a better Windows than Windows." More recently, IBM has backed down a bit from these claims, but the company is still emphasizing the superior reliability of OS/2 running Windows applications as opposed to Windows running Windows applications. Nobody finds this particularly hard to believe. Just about anyone who runs Windows has experienced at least one or two major crashes, and those of us who develop Windows programs are privileged to watch the entire system regularly fall on its face. I just love it when I type Exit in a Windows DOS box, only to have the screen flash horribly and then find myself again at the DOS prompt—except that Windows and all the applications I was running while I was temporarily using the DOS box are history. This brings up the obvious question: If both OS/2 and Windows run in protected mode, just why is Windows such a fragile environment?

The primary reason, of course, is that Windows is a multitasking, graphical environment layered on top of a single-tasking, character-oriented operating system, and the relationship between the two is not, to put it kindly, elegant. Windows relies on all sorts of undocumented DOS structures and functions, captures many DOS and ROM BIOS interrupt vectors, and inserts legions of little tendrils and hooks into DOS's innards. Moreover, Windows contains its own memory manager and its own suite of device drivers, which must somehow coexist with the DOS memory manager and device drivers. This is a classic example of a statue of gold (well, okay, maybe silver) with feet of clay.

For the first two versions of Windows, there was quicksand under the feet of clay, as well: the Intel 80x86 real mode, which required Windows to use a truly Byzantine scheme for virtual memory management and allowed an errant application to scribble anywhere in memory. In spite of this hardware deficiency, the earliest versions of Windows did not even make a token attempt to check the parameters that were passed to an API function by an application before using them! If the application supplied a bad pointer or handle, the function call would not only fail but it could take the whole system down with it. Sometimes, unfortunately, the damage would be subtle enough that the application or the system would continue to run for quite a while before staggering to a halt, making the original cause of the problem nearly impossible to track down.

A sample program lets you explore ToolHelp's facilities for installing a notification callback routine for Windows API parameter errors.

The basic instability of Windows has always been complicated by the fact that Windows applications have tended to be, frankly, very buggy. Try running any large first- or second-generation Windows application on a Windows system with the debugging kernel installed and you'll be astonished at the number of diagnostic messages. Microsoft deserves most of the blame for this. In the earliest days of Windows, the message traffic, the relationships between events, and the interdependencies of Windows API functions were very poorly documented; the debugging facilities were crude; and the debugging hooks were a closely guarded secret, which prevented third parties from supplying more capable debuggers. Consequently, most developers had only a dim understanding of how the system as a whole really fit together, and they built their programs by cutting and pasting source code from other, previously working programs or by cloning source code published by Windows gurus like Charles Petzold and Michael Geary.

Windows 3.0, which was the first version of the operating environment to run in protected mode, brought with it the dreaded UAE (Unrecoverable Application Error). It's important to note, however, that UAEs were (for the most part) not a symptom of new problems with applications and Windows itself; rather they were an unmasking of old problems. In protected mode, use of a bad pointer caused an immediate General Protection fault (a special hardware interrupt) instead of an unpredictable amount of damage and a crash somewhere down the road. The Windows 3.0 developers were apparently so rattled by the whole concept of GP faults that they decided to handle them all in a very conservative way: terminating the active application and displaying a scary dialog box that warned the user to restart his machine immediately or suffer the consequences, even though in the vast majority of cases the system itself was undamaged. Inexpli-

cably, they still made no attempt to perform sanity checks on the parameters of Windows function calls. Windows was probably the only general-purpose multitasking environment in computer history to place such total faith in the correctness of the applications that ran under its control.

Microsoft didn't really get interested in improving the robustness of Windows until after the Great Divorce from IBM, when it suddenly became apparent that the stability of Windows was going to be a crucial competitive issue. During the period between Windows 3.0 and 3.1, Microsoft took many laudable—if sadly overdue—steps to improve life for Windows programmers. A utility called Dr. Watson, which trapped application errors and wrote diagnostic information to a file on-disk, was distributed to developers and users via bulletin boards and online services. A TEST program was provided that allowed programmers to exercise their applications under a variety of stressful conditions. A single-screen debugger was released, and many previously mysterious aspects of the system were cleaned up and documented. Microsoft also implemented a new dynamic link library, called TOOLHELP.DLL, that gave applications access to certain internal Windows structures and made it possible to write debuggers using officially supported interfaces. The ToolHelp functions are summarized in Figure 1. This library was licensed, along with the Windows header files and import libraries, to third-party developers, which set off an explosive evolution in Windows programming tools.

Finally, with the release of Windows 3.1; Microsoft made TOOLHELP.DLL and Dr. Watson an integral part of the retail Windows package and incorporated parameter validation and local reboot into the system. *Parameter validation* means that Windows checks most arguments for an application function call for "reasonable" values before executing the function. If a parameter is bogus, Windows will take what it feels to be an appropriate action. In some cases, it simply ignores the function call or returns an error to the calling program; in others, it gives the user the opportunity to abort the application. *Local reboot* means that Windows traps the Ctrl-Alt-Del key combination and gives the user the option of simply killing the current program rather than resetting the entire system.

THE BADAPP PROGRAM To give you a test-bed for playing around with Windows 3.1's parameter validation, fault trapping, Dr. Watson, and local reboot, I've written a toy program called BADAPP. The C source code for BADAPP is found in Figure 2 (for reasons of space, the header file, module definition file, and resource script are not shown here). BADAPP uses the same table-driven structure for message handling and menu decoding that I introduced in my previous series of columns on the Windows 3.1 Common Dialogs. All of the source files and the executable file for BADAPP can be downloaded as BADAPP.ZIP from the Programming Forum on PC MagNet, or can be obtained by writing *PC Magazine* (see instructions at the end of this column).

The source code for BADAPP is so simple that it should be self-explanatory, and BADAPP is a pretty trivial program from the user's point of view as well. The File pop-up menu has only one item, Exit, that is used to shut down the program in the "normal" manner. The Crash pop-up menu offers several choices: GP Fault, Divide by Zero, Pass Bad Pointer, Infinite Loop, and Pass Bad HDC (device context handle). Each of the Crash menu items tests a different aspect of Windows 3.1's ability to detect and protect itself from severe application bugs. You'll notice some interesting differences in the way Windows handles these five cases.

Parameter validation means that Windows checks most arguments for an application function call for "reasonable" values before executing the function.

Selection of the GP Fault menu item causes control to pass to the DoMenuGPFault() routine, which allocates a far pointer on the stack, initializes it to zero, and then dereferences it. Windows intercepts the resulting GP fault and puts up a Close or Ignore dialog box. If you pick Close, Windows terminates BADAPP unilaterally. If you choose Ignore, Windows allows the application to continue its execution. This has no particularly bad implications in the BADAPP program, because BADAPP doesn't do anything with the data it is fetching via the invalid pointer. A real application would, of course, end up processing garbage if the user picked Ignore, most likely leading to another GP fault or some other catastrophe within a very short time.

The Divide by Zero and Pass Bad Pointer menu commands cause BADAPP to call the DoMenuZeroDiv() and DoMenuBadPtr() routines, respectively. The first of these routines demands an integer-divide-by-zero operation that Borland C++, for performance reasons, compiles as in-line code without any error

The ToolHelp Functions

Function category	Function names
Window information	ClassFirst(), ClassNext(), GetClassInfo()
Task and module information	ModuleFirst(), ModuleNext(), ModuleFindHandle(), ModuleFindName(), TaskFirst(), TaskNext(), TaskFindHandle()
Memory information	SystemHeapInfo(), MemManInfo()
Global heap information	GlobalInfo(), GlobalFirst(), GlobalNext(), GlobalEntryHandle(), GlobalEntryModule()
Local heap information	LocalInfo(), LocalFirst(), LocalNext()
Stack information()	StackTraceFirst(), StackTraceNext(), StackTraceCSIPFirst()
Execution timing information	TimerCount()
Huge object access	MemoryRead(), MemoryWrite(), GlobalHandleToSel()
Error callbacks	InterruptRegister(), InterruptUnRegister(), NotifyRegister(), NotifyUnRegister()
Process control	TaskGetCSIP(), TaskSetCSIP(), TaskSwitch(), TerminateApp()

***Figure 1:* A summary of the functions exported by TOOLHELP.DLL.**

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checking. The second routine calls the Windows API function MessageBox with a null pointer for the string to be displayed within the message box. In both cases, Windows shuts down the application immediately without any option to continue. The handling of Pass Bad Pointer is a little surprising, because Windows could use the Intel 80286 VERR instruction to check out the pointer "for free" before trying to use it, and just fail the function call if the pointer was invalid. Apparently, however, Windows just dereferences the pointer blindly, a GP fault occurs within the Windows kernel, and all this leads to a UAE condition for the application.

If you pick Infinite Loop, BADAPP calls its DoMenuHang routine, which consists mainly of a while(TRUE){} structure, and the entire system enters a funny state. The screen looks okay and the mouse pointer will still move around on the screen, but nothing else works. This is because the mouse generates interrupts, and interrupts are not masked (since the infinite loop occurs at the application level rather than within the Windows kernel), so the mouse driver can continue to monitor the mouse's location and update the screen accordingly. All other Windows activities, however, necessarily come to a screeching halt because Windows multitasking is cooperative rather than preemptive. If the application is in an infinite loop, it never processes its own queue messages or yields control, and other applications never get a chance to process messages, either. If you press the Ctrl-Alt-Del key combination, a keyboard interrupt occurs, the keyboard driver gets control, and it calls the Windows local reboot routine, which gives you the choice to continue execution, abort the current appli-

BADAPP.C
1 of 2

```
// BADAPP - Application Error Testbed for Windows 3.1
// Copyright (C) 1992 Ray Duncan
// Ziff Davis Publishing * PC Magazine

#define dim(x) (sizeof(x) / sizeof(x[0]))   // returns no. of elements

#include "windows.h"
#include "badapp.h"

HANDLE hInst;                               // module instance handle
HWND hFrame;                                // handle for frame window

char szShortAppName[] = "BadApp";           // short application name
char szAppName[] = "BadApp - UAE Tester";   // long application name
char szMenuName[] = "BadAppMenu";           // name of menu resource

struct decodeWord {                         // structure associates
    UINT Code;                              // messages or menu IDs
    LONG (*Fxn)(HWND, UINT, UINT, LONG); }; // with a function

//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
//
struct decodeWord messages[] = {
    WM_PAINT, DoPaint,
    WM_COMMAND, DoCommand,
    WM_DESTROY, DoDestroy, } ;

//
// Table of menubar item IDs and their corresponding functions.
//
struct decodeWord menuitems[] = {
    IDM_EXIT, DoMenuExit,
    IDM_GPFAULT, DoMenuGPFault,
    IDM_HANG, DoMenuHang,
    IDM_ZERODIV, DoMenuZeroDiv,
    IDM_BADHDC, DoMenuBadHDC,
    IDM_BADPTR, DoMenuBadPtr, } ;

//
// WinMain -- entry point for this application from Windows.
//
INT APIENTRY WinMain(HANDLE hInstance,
    HANDLE hPrevInstance, LPSTR lpCmdLine, INT nCmdShow)
{
    MSG msg;

    hInst = hInstance;                      // save this instance handle

    if(!hPrevInstance)                      // if first instance,
        if(!InitApplication(hInstance))     // register window class
            return(FALSE);                  // exit if couldn't register

    if(!InitInstance(hInstance, nCmdShow))  // create this instance's window
        return(FALSE);                      // exit if create failed

    while(GetMessage(&msg, NULL, 0, 0))     // while message != WM_QUIT
    {
        TranslateMessage(&msg);             // translate virtual key codes
        DispatchMessage(&msg);              // dispatch message to window
    }

    TermInstance(hInstance);                // clean up for this instance
    return(msg.wParam);                     // return code = WM_QUIT value
}

//
// InitApplication --- global initialization code for this application.
//
BOOL InitApplication(HANDLE hInstance)
{
    WNDCLASS  wc;

    // set parameters for frame window class
    wc.style = CS_HREDRAW|CS_VREDRAW;       // class style
    wc.lpfnWndProc = FrameWndProc;          // class callback function
    wc.cbClsExtra = 0;                      // extra per-class data
    wc.cbWndExtra = 0;                      // extra per-window data
    wc.hInstance = hInstance;               // handle of class owner
    wc.hIcon = LoadIcon(hInst, "BadAppIcon");       // skull icon
    wc.hCursor = LoadCursor(NULL, IDC_ARROW);       // default cursor
    wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
    wc.lpszMenuName =  szMenuName;          // name of menu resource
    wc.lpszClassName = szShortAppName;      // name of window class

    return(RegisterClass(&wc));             // register class, return status
}

//
// InitInstance --- instance initialization code for this application.
//
BOOL InitInstance(HANDLE hInstance, int nCmdShow)
{
    hFrame = CreateWindow(                  // create frame window
        szShortAppName,                     // window class name
        szAppName,                          // text for title bar
        WS_OVERLAPPEDWINDOW,                // window style
        CW_USEDEFAULT, CW_USEDEFAULT,       // default position
        CW_USEDEFAULT, CW_USEDEFAULT,       // default size
        NULL,                               // no parent window
        NULL,                               // use class default menu
        hInstance,                          // window owner
        NULL);                              // unused pointer

    if(!hFrame) return(FALSE);              // error, can't create window

    ShowWindow(hFrame, nCmdShow);           // make frame window visible
    UpdateWindow(hFrame);                   // force WM_PAINT message
    return(TRUE);                           // return success flag
}

//
// TermInstance -- instance termination code for this application.
//
BOOL TermInstance(HANDLE hinstance)
{
    return(TRUE);                           // return success flag
}

//
// FrameWndProc --- callback function for application frame window.
//
LONG FAR APIENTRY FrameWndProc(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    int i;                                  // scratch variable

    for(i = 0; i < dim(messages); i++)      // decode window message and
    {                                       // run corresponding function
        if(wMsg == messages[i].Code)
            return((*messages[i].Fxn)(hWnd, wMsg, wParam, lParam));
    }

    return(DefWindowProc(hWnd, wMsg, wParam, lParam));
}

//
// DoCommand -- process WM_COMMAND message for frame window by
// decoding the menubar item with the menuitems[] array, then
// running the corresponding function to process the command.
```

Figure 2: **BADAPP.C, the C-language source code for the BADAPP demonstration program.**

BADAPP.C

2 of 2

```
//
LONG DoCommand(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    int i;                                  // scratch variable

    for(i = 0; i < dim(menuitems); i++)     // decode menu command and
    {                                       // run corresponding function
        if(wParam == menuitems[i].Code)
            return((*menuitems[i].Fxn)(hWnd, wMsg, wParam, lParam));
    }

    return(DefWindowProc(hWnd, wMsg, wParam, lParam));
}

//
// DoDestroy -- process WM_DESTROY message for frame window.
//
LONG DoDestroy(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    PostQuitMessage(0);                     // force WM_QUIT message to
    return(FALSE);                          // terminate the event loop
}

//
// DoPaint -- process WM_PAINT message for frame window.  Select
// a pretty font, then display a message in the center of the window
// to show that the program is alive.
//
LONG DoPaint(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    RECT rect;
    HFONT hfont;

    hdc = BeginPaint(hWnd, &ps);            // get device context
    GetClientRect(hWnd, &rect);             // get client area dimensions
    hfont = CreateFont(-36, 0, 0, 0, 700, TRUE, 0, 0, ANSI_CHARSET,
        OUT_DEFAULT_PRECIS, CLIP_DEFAULT_PRECIS,
        DEFAULT_QUALITY, (FF_MODERN << 4) + DEFAULT_PITCH,
        "Ariel");
    SelectObject(hdc, hfont);               // select new font
    DrawText(hdc, "I'm Really Bad!", -1,    // paint text in window
        &rect, DT_CENTER | DT_VCENTER | DT_SINGLELINE);
    EndPaint(hWnd, &ps);                    // release device context
    return(FALSE);
}

//
// DoMenuExit -- process File-Exit command from menu bar.
//
LONG DoMenuExit(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    SendMessage (hWnd, WM_CLOSE, 0, 0L);    // send window close message
    return(FALSE);                          // to shut down the app
}

//
// DoMenuGPFault -- process GP Fault command from menu bar.  Force
// a fault by dereferencing a null pointer.
//
LONG DoMenuGPFault(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    char c;
    char far *p = NULL;

    c = *p;                                 // dereference bogus pointer
    return(FALSE);                          // to force a GP fault
}

//
// DoMenuHang -- process Infinite Loop command from menu bar.
// Execute an infinite loop until the user forces a local reboot
// with Ctl-Alt-Del.
//
LONG DoMenuHang(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    while(TRUE)
    {
        // execute practically forever
    }

    return(FALSE);
}

//
// DoMenuZeroDiv -- process Divide by Zero command from menu bar.
// Declare some integers, then force a divide by zero fault.
//
LONG DoMenuZeroDiv(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    int i, j, k = 0;

    i = j / k;
    return(FALSE);
}

//
// DoMenuBadHDC -- process Bad HDC command from menu bar.  Call the
// DrawText() API function with a bogus HDC.
//
LONG DoMenuBadHDC(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    HDC hdc = 0;
    RECT rect;

    GetClientRect(hWnd, &rect);             // get client area dimensions
    DrawText(hdc, "Bogus HDC!", -1,         // use invalid HDC to paint text
        &rect, DT_CENTER | DT_VCENTER | DT_SINGLELINE);
    return(FALSE);
}

//
// DoMenuBadPtr -- process Bad Pointer command from menu bar.  Call the
// MessageBox() API function with a NULL pointer to the message string.
//
LONG DoMenuBadPtr(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    MessageBox(hWnd, NULL, NULL, MB_OK | MB_ICONSTOP);
    return(FALSE);
}
```

cation, or reset the machine entirely.

How about the Pass Bad HDC menu item? The corresponding BADAPP routine DoMenuBadHDC is implemented as a call to DrawText with a device context handle (HDC) of zero, and it appears to do nothing. The Windows developers apparently decided that this particular error fell into the category where they could safely ignore the function call and allow the application to continue. After all, the worst that could happen is that the user wouldn't see something on the screen that ought to be there. If you are running the special debugging Windows kernel, however, you will get a warning message about the invalid handle on the debugging terminal.

WORKING WITH TOOLHELP ToolHelp offers quite a diverse range of services, many of which we will be using in demonstration programs in this column over the next few issues. Just to get our feet wet, however, let's try out ToolHelp's facilities for installing a *notification callback routine* for Windows API parameter errors. Whenever the application requests a Windows function with an invalid parameter, Windows will (while the function call is still in progress) call back into the notification routine with information about the error. This allows the application to decide what to do about its own error, but more important, allows the programmer to run the application under completely natural conditions—no debugger, no separate debugging terminal, no special Windows debugging kernel—and still gather information about this particular class of bugs.

In order to use a notification callback routine in your own program, you must do the following:

- Register an application-specific window message in your application's instance initialization routine; this window message will be used by the notification callback routine to communicate with the body of your program.
- Allocate a thunk for the callback routine with MakeProcInstance() in the program's instance initialization routine.
- Register the notification callback routine with TOOLHELP.DLL by calling the function NotifyRegister() in the program's instance initialization routine.
- Implement the notification callback routine itself. This entry must be declared as BOOL FAR PASCAL. It accepts an unsigned single integer and an unsigned

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BADAPP2.C

Complete Listing

```
// BADAPP2 - Application Error Testbed for Windows 3.1
//           with Notification Callback
// Copyright (C) 1992 Ray Duncan
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#include "windows.h"
#include "toolhelp.h"
#include "badapp.h"
  .
  .
  .
WNDPROC lpNotifyCallback;               // NotifyCallback thunk addr
  .
  .
  .
//
// Table of window messages supported by FrameWndProc()
// and the functions which correspond to each message.
//
struct decodeWord messages[] = {
    0, DoNotifyMessage,
    WM_PAINT, DoPaint,
    WM_COMMAND, DoCommand,
    WM_DESTROY, DoDestroy, } ;
  .
  .
  .
//
// These structures receive error information during ToolHelp callback.
//
NFYLOGERROR nfylogerror;
NFYLOGPARAMERROR nfylogparamerror;
  .
  .
  .
//
// InitInstance --- instance initialization code for this application.
//
BOOL InitInstance(HANDLE hInstance, int nCmdShow)
{
  .
  .
  .
    // allocate private message number for use by NotifyCallback
    messages[0].Code = RegisterWindowMessage("BADAPP");

    // allocate thunk for callback then register it with ToolHelp.DLL
    lpNotifyCallback = MakeProcInstance((WNDPROC)NotifyCallback, hInst);
    NotifyRegister(NULL, lpNotifyCallback, NF_NORMAL);

    return(TRUE);                       // return success flag
}

//                                      .
// TermInstance -- instance termination code for this application.
//
BOOL TermInstance(HANDLE hinstance)
{
    NotifyUnRegister(NULL);             // unregister ToolHelp callback
    FreeProcInstance(lpNotifyCallback); // release callback
    return(TRUE);                       // return success flag
}
  .
  .
//
// DoNotifyMessage -- process private message from NotifyCallback
//
LONG DoNotifyMessage(HWND hWnd, UINT wMsg, UINT wParam, LONG lParam)
{
    UINT i;
    char *p;
    char temp[256];

    switch(wParam)
    {
        case NFY_LOGERROR:
            p = "NFY_LOGERROR";
            i = nfylogerror.wErrCode;
            break;

        case NFY_LOGPARAMERROR:
            p = "NFY_LOGPARAMERROR";
            i = nfylogparamerror.wErrCode;
            break;

        default:
            p = "Unknown";
            i = 0;
    }

    // now format and display NotifyCallback information
    wsprintf(temp, "Notify type: %s\nError code: %04Xh", (LPSTR) p, i);
    MessageBox(hWnd, temp, "BadApp", MB_OK | MB_ICONEXCLAMATION);

    return(FALSE);
}
  .
  .
  .
//
// NotifyCallback -- callback routine for ToolHelp DLL.  Looks for
// codes indicating a parameter validation error in an API call,
// saves information about the error, and posts a message to the
// main message handling routine indicating that an error occurred.
//
BOOL FAR APIENTRY NotifyCallback(UINT wID, LONG dwData)
{
    switch(wID)
    {
        case NFY_LOGERROR:              // API parameter error
            nfylogerror = *(NFYLOGERROR far *) dwData;
            PostMessage(hFrame, messages[0].Code, wID, 0);
            return(TRUE);               // signal callback was handled

        case NFY_LOGPARAMERROR:         // API parameter error
            nfylogparamerror = *(NFYLOGPARAMERROR far *) dwData;
            PostMessage(hFrame, messages[0].Code, wID, 0);
            return(TRUE);               // signal callback was handled

        default:
            return(FALSE);              // signal callback not handled
    }
}
```

Figure 3: **Extracts from BADAPP2.C, a modified version of BADAPP with notification callback handling. The full source code is available on PC MagNet.**

double integer as parameters; the single value is an error code and the double value is usually a far pointer to a structure that contains more information about the error. The callback routine is not allowed to do very much except call ToolHelp functions, make a copy of the error information in local static variables, and post a message to one of the application's window handlers.

- Add appropriate logic to one of the application's window handlers to process the message posted by the notification callback and take appropriate action (for example, log the error to a disk file or display an alert dialog).
- Modify the application's termination code to call the ToolHelp function NotifyUnRegister; this allows TOOLHELP.DLL to deallocate those of its internal data structures that are associated with the application.
- Add static NFYLOGERROR or NFYLOGPARAMERROR structures to the program; these can be used by the notification callback routine to make local copies of the error information that is passed to it.
- Export the notification callback routine in the application's module definition (.DEF) file.

To illustrate these steps, I have modified the BADAPP.C source code to create a new program, BADAPP2.C, which contains a notification callback. We could not print the entire listing, but extracts of BADAPP2's source code, showing the portions that are specific to the handling of notification callbacks, can be found in Figure 3. As always, you can get the full source code and executable file for BADAPP2.C by downloading it from PC MagNet, or by sending a postcard with your name and address to the attention of Katherine West, PC Magazine, One Park Ave., New York, NY 10016; (no phone calls, please).

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CIRCLE 342 ON READER SERVICE CARD

Memo-File Bloat: Why Clipper memo files seem to grow forever, and how FlexFile can help.

BY SAL RICCIARDI

Memo-File Bloat

I use a Clipper Summer '87 application with a large database that contains memo fields. Every time the memo fields are amended, the memo file grows considerably in size. As a result, we have to compact the memo file by issuing the COPY TO command to copy the database to temporary files, deleting the originals and then renaming the new files. This means we have to keep a lot of unused space available on our hard disk to accommodate the duplicate files. Is there any way to compact the memo file without copying the whole database? We have a copy of Clipper 5.0. Does that version solve the problem?

A.L. Blackman
Pucklechurch, Avon
England

▶**PC MAGAZINE** Clipper 5.0 doesn't offer any solution to this problem, because it uses the same memo-file system that Clipper Summer '87 uses. One good approach to minimizing the memo-file bloat problem, however, is to replace the existing memo-file format entirely, since it dates back to dBASE III Plus and is poorly designed. But before I digress too far, let's discuss how Clipper's memo files work and what causes this problem to begin with. Please note that this discussion applies only to Clipper's memo files; other products, (FoxPro, for example) have different ways of storing memo files.

Clipper stores memo data in fixed-size blocks of 512 bytes each. The first block in the memo file, block 0, contains a special header that holds the block number of the next available block in the memo file. (Blocks are numbered sequentially starting with 0.)

When you add a new record to your database and place some data in the memo field, Clipper adds the data to the end of the memo file. First, it locates the next available block number by reading the memo-file header. Then it uses that number to calculate an offset address at which to store the memo in the memo file. For example, if the next available block number is 2, Clipper calculates 2 times 512 and uses 1,024 as the offset at which to store the memo. Clipper then writes the memo data starting at that offset, using as many consecutive 512-byte blocks as are needed.

One good approach to minimizing the memo-file bloat problem is to replace the existing memo file format entirely, since it is poorly designed.

The block number is then stored in the memo field in the .DBF file, and the next available block number is updated in the memo file header. If the data being stored occupies more than one 512 byte block, the next available block number will be incremented accordingly. In this way, .DBF records that have data stored in a memo file contain the block number where that data begins. Figure 1 diagrams the relationship between .DBF records and the .DBT memo-file contents.

You can see that the above method is fairly straightforward. Unfortunately, the system breaks down when you alter memo-field data or delete records. When you edit data in the memo field, if your changes cause the memo field to grow larger than the number of 512-byte blocks allocated to it, the existing data is abandoned (but remains in the memo file) and the entire changed data is written starting with the next available block. This is a principal cause of memo-file bloat, since the space devoted to the abandoned data is never recovered.

Clipper actually improves upon dBASE III Plus in this area, since Clipper will allocate new space only if your memo data grows beyond a 512-byte boundary. dBASE III Plus writes to a new block every time you make a change, even if you only change a single byte.

Another problem occurs when you delete records in the database. If you use the traditional method of issuing the DELETE command followed later by a PACK, you'll find that the memo-file size does not shrink at all. This is because Clipper does not reuse the space in the memo file allocated to deleted records. The result: Every time you delete a record that has data stored in a memo field, you're increasing the amount of dead space in the memo file.

The traditional way to remove the bloat from memo files is to use the COPY TO command to create a second copy of the database. When Clipper copies the database file, it only copies memo-file blocks that are currently being used to store real data. But this approach requires enough free disk space to hold the copied files and can be time-consuming.

One useful alternative when developing Clipper applications is FlexFile, a third-party API library. FlexFile, which uses true variable-length fields (VLFs),

.DBF Memo-File Structure

.DBF file		.DBT file		
Record number	*hidden contents of memo field (block number)*	*Block number*	*Byte offset*	*Contents*
1	1	0	0–511	Memo file header
2	3	1	512–1023	Memo for record 1
3	—	2	1024–1535	Memo for record 1 continued
4	—	3	1536–2047	Memo for record 2
5	7	4	2048–2559	Memo for record 2 continued
		5	2560–3071	Memo for record 2 continued
		6	3072–3583	Abandoned
		7	3584–4095	Memo for record 5
		8	4096–4608	Memo for record 5 continued

Figure 1: **This diagram shows the relationship between the memo fields in a Clipper .DBF file and the contents of the memo file itself.**

is a complete replacement for the Clipper .DBT system. Instead of allocating data in 512-byte blocks, FlexFile requires only a 6-byte header in addition to the storage required for the memo itself. This means a 100-byte memo field that occupies 512 bytes using a .DBT file will only occupy 106 bytes using FlexFile.

FlexFile's storage algorithms are smart enough to automatically reuse any space that becomes available. For example, if you delete a record, the space allocated to the memo automatically becomes available and will be reused. Likewise, when you alter a memo, any space made available as a result of your changes is also reused. In this way, FlexFile helps avoid the dreaded memo-file bloat.

To use FlexFile in an application, you must incorporate FlexFile's library functions into your program and include in your database structure a 6-byte character field wherever you would otherwise have a memo field. FlexFile uses the 6-byte character field to store a pointer to FlexFile's VLF version of the memo file, similar to the way the .DBT system uses a 10-byte memo field to hold a memo file block number.

Once your database is set up, you use the following code to open the database and its associated VLF:

```
USE database
V_USE("database.dbv")
```

The first line opens the database. The second line tells FlexFile to open the appropriate .DBV file. (FlexFile uses the .DBV file extension for its VLF files.)

The product includes approximately 40 V_ functions for managing VLF files, some of which are named after their Clipper equivalents. For example, FlexFile implements its own work areas, which you select using V_SELECT(). To return the alias name of an open work area, use V_ALIAS(); to replace a memo in a VLF you use V_REPLACE(); and so on.

To access data stored in a VLF you use the V_RETRIEVE function. For example, to store the contents of a VLF field named `vlffld` to a variable named `var`, you would use:

```
var = V_RETRIEVE( vlffld )
```

Similarly, to replace the `vlffld` field with the contents of the variable, you would use:

```
REPLACE vlffld WITH ;
  V_REPLACE( var, vlffld )
```

In this manner you convert your standard Clipper programs to FlexFile by substituting FlexFile's V_ functions where needed.

The product offers two additional advantages over Clipper's .DBT system. First, your VLF files are limited only by available disk space. Clipper's .DBT's have a practical limit of 32MB. Second, FlexFile can store any type of data in the memo file, including binary graphics images, executable files, and so on. Clipper, on the other hand, is limited in what it can store in a memo file since certain binary values have specific meaning to the .DBT system—CHR(0) and CHR(26), for instance.

FlexFile can store and retrieve any valid Clipper data, including arrays, character strings, dates, numerics, and logicals. The ability to store variable-size arrays can be handy in some applications, as it lets you vary the number of elements on a case-by-case basis. You could, for example, store a variable number of phone numbers and contact names for a customer record without having to (necessarily) add tables and relations.

Since Clipper's arrays are themselves *ragged*—meaning you can store a variable number of different types of items in each element or subarray—this adds a multidimensional aspect to your database designs. FlexFile can also store and retrieve Clipper and Class(y) objects. Class(y) is a third-party product from Integrated Development Corp. (190 Main St., Hampstead, NH 03841; 800-333-3429, 603-329-5522) that lets you create user-defined object classes in Clipper.

In addition to VLFs, FlexFile includes an implementation of strongly typed multidimensional arrays that are more memory efficient and that supplement Clipper's built-in arrays. FlexFile arrays can only hold elements of the same type but can be much larger than Clipper arrays, and FlexFile arrays support an expanded choice of data types.

FlexFile sells for $149. If you would like more information about this product, you should contact Ganahl Software, 3333 W. Commercial Blvd., #113, Ft. Lauderdale, FL 33309; 800-285-3539, 305-484-7784. □

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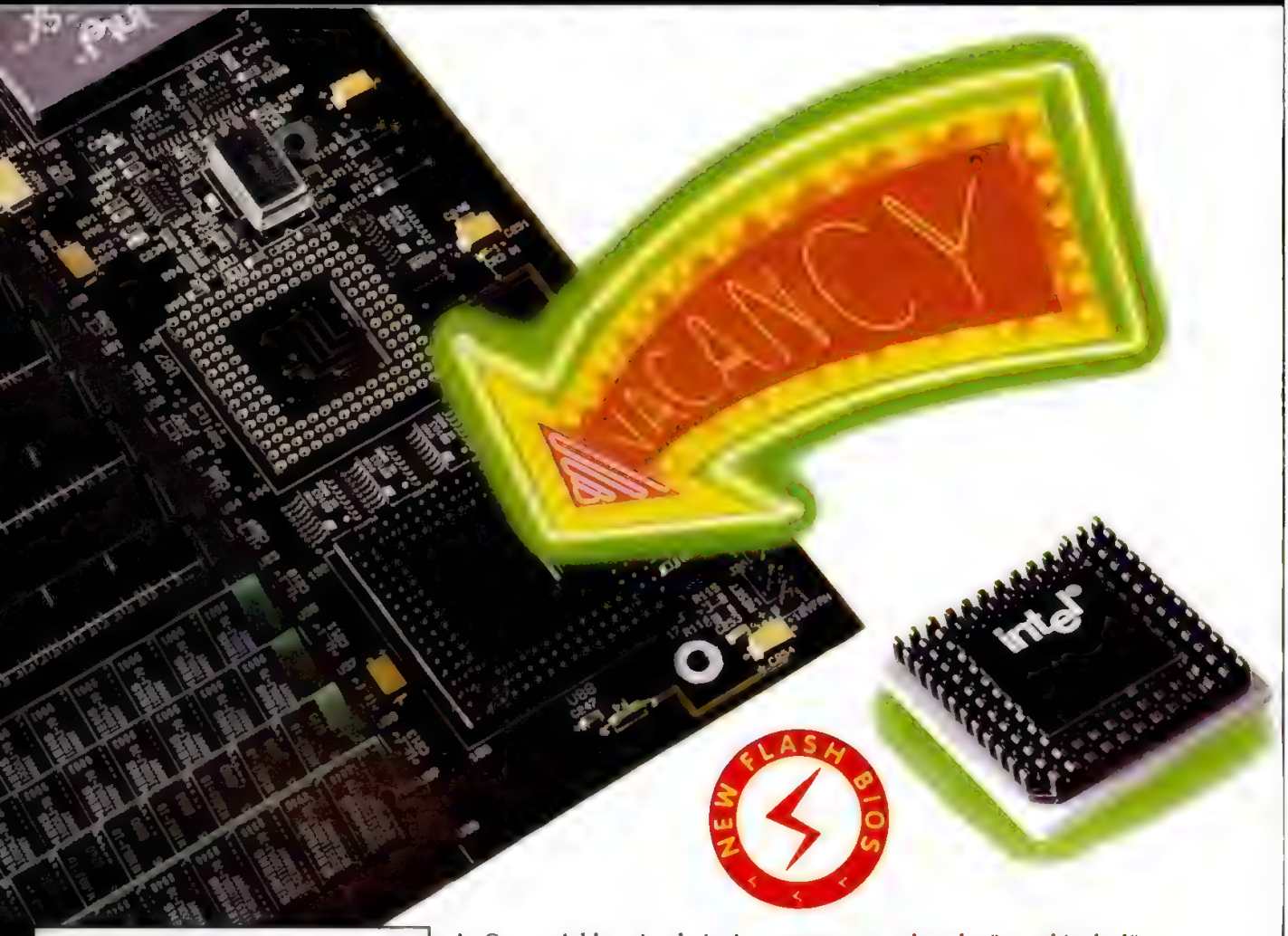

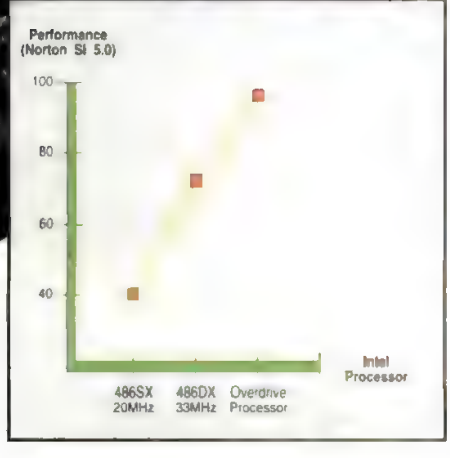

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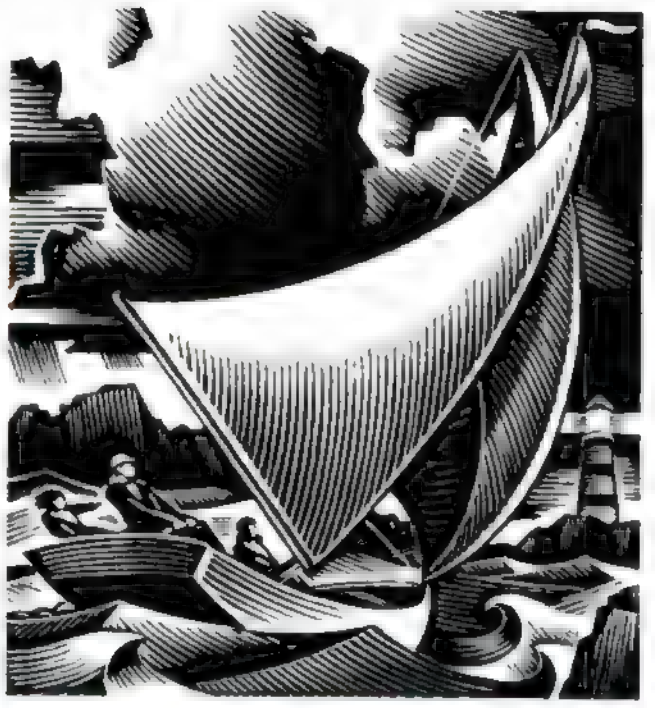

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LANGUAGES

Radix Conversions: Here's how to convert numbers to binary, hex, or octal with C and C++

EDITED BY SHARON TERDEMAN

Radix Conversions

Here's a Turbo C program I wrote that converts numbers from one radix (or base number) to another. In other words, a decimal number is converted to hexadecimal (base 16), octal (base 8), or binary (base 2), and vice versa.

Madhav Iyer
West Point, Pennsylvania

▶PC MAGAZINE Radix conversions are a regular necessity for programmers. But while hex calculators are relatively common, you don't always happen to have one handy. The standard C library makes base-number conversions relatively easy to do. With the exception of binary, you can make any and all conversions to or from hexadecimal, octal, and decimal using printf or one of its derivatives.

C++ has features that make these conversions even easier. So I created two versions of the program, one in C and the other in C++. They work the same way, but the C++ version uses the C++ IOSTREAM operators to format output. The C++ version also takes advantage of C++'s facility for introducing new local variables anywhere in the body of a function—not just at the inception of a function. The two resulting programs, CNVRTC.C and CNVRTCPP.CPP, which are shown in Figures 1 and 2, respectively, compile to CNVRTC.EXE and CNVRTCPP.EXE. You can try out both programs and compare the results. CNVRTC can be downloaded from PC MagNet, archived as CNVRTC.ZIP and CNVRTCPP can be downloaded, archived as CNVCPP.ZIP.

Both versions of the program compile with Borland C++ 2.0 and 3.0, and the C version compiles with Microsoft C 6.0a. To compile them for Borland C++, use

```
bcc cnvrtc.c
```

for the C version and

```
bcc cnvrtcpp
```

for the C++ program. To compile with Microsoft C, use

```
cl cnvrtc.c
```

The original program was unnecessarily long and complex, so I simplified it in several places. First, I changed the program's command line so it only expects two arguments (instead of three)

```
CNVRTC <number>[radix]
```

where *number* is the number being converted and *radix* is its current base. (All examples are identical for CNVRTCPP.) Thus

```
CNVRTC 10d
```

will convert decimal 10 and

```
CNVRTC 10h
```

will convert hex 10 (decimal 16).

CNVRT presents the results in all four radices: binary, octal, decimal, and hexadecimal. In the case of the last three, it uses a call to the sscanf library function—a printf derivative—to convert the command line argument into an integer by using a specific formatting string. In each case, the program uses a table lookup to find the correct radix and conversion string (see CnvtTable in Figure 2).

CNVRTC.C
1 of 2

```
// cnvrtc.c RHS 12/25/9.

#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include<ctype.h>

char *binarystrs[8] = { "000", "001", "010", "011",
                        "100", "101", "110", "111" };

char *oct2bin(char *octstr, char *binstr)
    {
    char *temp = binstr;

    for( *binstr = ' '; *octstr; octstr++)
        {
        strcpy(binstr,binarystrs[(*octstr)-'0']);
        binstr += 3;
        }
    for(binstr = temp; *binstr == '0'; binstr++);
    strcpy(temp,binstr);
    return temp;
    }

long bin2dec(char *binstr)
    {
    long result = 0L;

    for( ; *binstr; binstr++)
        result = (result*2) + (*binstr-'0');
    return result;
    }
```

Figure 1: This is the source code for a C language program that converts numbers from one radix to another.

CNVRTC.C

2 of 2

```
typedef struct _convert
    {
    char type;
    char *fmtstr;
    } Convert;

Convert CnvtTable[3] =
    {
    {   'o',"%lo",   },
    {   'd',"%lu",   },
    {   'h',"%lx",   }
    };

void main(int argc, char **argv)
    {
    char *number = argv[1];
    char radix = '\0';
    long result;
    int i;
    char octstr[15], binstr[40];

    if(argc != 2)
        {
usage:
    printf( "Usage: CONVERT <n>[r]\n"
            "\twhere n >= 0 and n >= 4294967295 and 'r' is the radix (b,o,h,d)\n"
            "\tand 'r' is the radix (b,o,h,d)\n"
            "\texamples: 10b Ah 3d 4o (binary 10, A hex, 3 decimal, 4 binary\n"
            "\t(numbers without a radix are assumed to be decimal)\n");
        exit(0);
        }

    radix = '\0';
    radix = number[strlen(number)-1];

    if(!isalpha(radix))
        radix = 'd';
    else
        number[strlen(number)-1] = '\0';

    switch(tolower(radix))
        {
        case 'b':
            result = bin2dec(number);
            break;

        case 'o':
        case 'h':
        case 'd':
            for(i = 0; i < 3; i++)
                if(radix == CnvtTable[i].type)
                    {
                    sscanf(number,CnvtTable[i].fmtstr,&result);
                    break;
                    }
            break;

        default:
            goto usage;
        }

    sprintf(octstr,"%lo",result);
    printf("%sb = ",oct2bin(octstr,binstr));
    printf("%loo = %lud = %lxh\n",result,result,result);
    }
```

CNVRTCPP.C

Complete Listing

```
// cnvtcpp.cpp  RHS 12/25/91

#include<stdio.h>
#include<iostream.h>
#include<stdlib.h>
#include<string.h>
#include<ctype.h>

char *binarystrs[8] = { "000", "001", "010", "011",
                        "100", "101", "110", "111" };

char *oct2bin(char *octstr, char *binstr)
    {
    char *temp = binstr;

    for( *binstr = ' '; *octstr; octstr++)
        {
        strcpy(binstr,binarystrs[(*octstr)-'0']);
        binstr += 3;
        }
    for(binstr = temp; *binstr == '0'; binstr++);
    strcpy(temp,binstr);
    return temp;
    }

unsigned long bin2dec(char *binstr)
    {
    unsigned long result = 0L;

    for( ; *binstr; binstr++)
        result = (result*2) + (*binstr-'0');
    return result;
    }

typedef struct _convert
    {
    char type;
    char *fmtstr;
    } Convert;

Convert CnvtTable[3] =
    {
    {   'o',"%lo",   },
    {   'd',"%lu",   },
    {   'h',"%lx",   }
    };

void main(int argc, char **argv)
    {
    if(argc != 2)
        {
usage:
   cout << "Usage: CONVERT <n>[r]\n"
           "\twhere n >= 0 and n >= 4294967295 and 'r' is the radix (b,o,h,d)\n"
           "\texamples: 10b Ah 3d 4o (binary 10, A hex, 3 decimal, 4 binary\n"
           "\t(numbers without a radix are assumed to be decimal)\n";
    exit(0);
    }

char *number = argv[1];
char radix = '\0';

radix = '\0';
radix = number[strlen(number)-1];

if(!isalpha(radix))
    radix = 'd';
else
    number[strlen(number)-1] = '\0';

unsigned long result;

switch(tolower(radix))
    {
    case 'b':
        result = bin2dec(number);
        break;
    case 'o':
    case 'h':
    case 'd':
        int i;
        for(i = 0; i < 3; i++)
            if(radix == CnvtTable[i].type)
                {
                sscanf(number,CnvtTable[i].fmtstr,&result);
                break;
                }
        break;

    default:
        goto usage;
    }

char octstr[15], binstr[40];
sprintf(octstr,"%lo",result);
char *equal_sep = " = ";

cout << oct2bin(octstr,binstr) << 'b' << equal_sep;
cout << oct << result << 'o' << equal_sep;
cout << dec << result << 'd' << equal_sep;
cout << hex << result << 'h';
cout << '\n';
}
```

Figure 2: **This is the source code for a C++ program that also does base number conversions.**

Converting a binary command line argument is slightly more complex. I used some of the code from the original program to create a function, bin2dec, that returns a decimal integer based on a string argument. This function scans each character of the string, subtracts 0 from it (thus, 0 - 0 is 0, and 1 - 0 is 1), and accumulates that value into a total result. Before adding each new value to the previously accumulated total, bin2dec doubles the total, thus effectively adding each successive character to the total at a power of two less than the previous one.

Alternatively, you could have written the function to start at the end of the string, converted each digit, and multiplied it by a power of two that increased with each loop iteration. I chose to leave this part of the code as it was, but the results are the same in any case.

After converting the command line argument, the program needs to convert whatever results it obtains into all four bases. Again, it uses printf to convert to octal, decimal, and hexadecimal. But for binary, CNVRT uses another custom function: oct2bin. It's easier to convert octal to binary since there are three binary digits for every octal digit, so oct2bin uses a table lookup to perform the conversion. The lookup table, binarystrs, contains a string that looks like the binary equivalent of any given octal value. Since octal values run from 0 to 7, the strings start with 000 and end with 111.

To find a particular string, you use the value of an octal digit as an index into the table. Thus

```
binarystrs[3]
```

will return the binary equivalent of three, or 011. Simple and neat.

Finally, I changed the program to handle unsigned longs rather than signed integers. This allows the user to convert numbers up to 4294967295 decimal, rather than the 32767 that was the original limit. Note that while this meant changing the printf format strings in the C version, the IOSTREAM operators in C++ (hex, oct, dec) effortlessly accepted the change in the data type. The result: a simpler, more powerful, easier-to-maintain program that's about 20 lines shorter.

Note also that CNVRTC offers very little error checking: It's easy enough for someone to put characters other than 0s or 1s in a binary argument or A through F in an argument that's not specified as hexadecimal. But I figured that programmers will use the program, and in this respect, programmers know better. □
—Richard Hale Shaw

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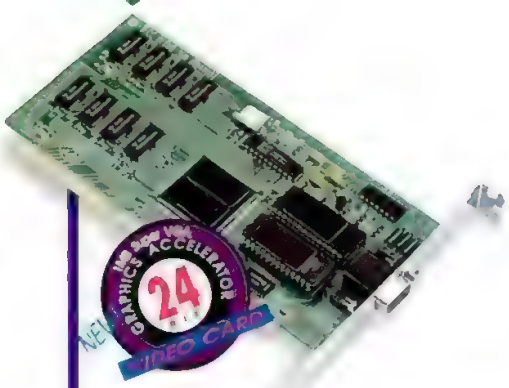

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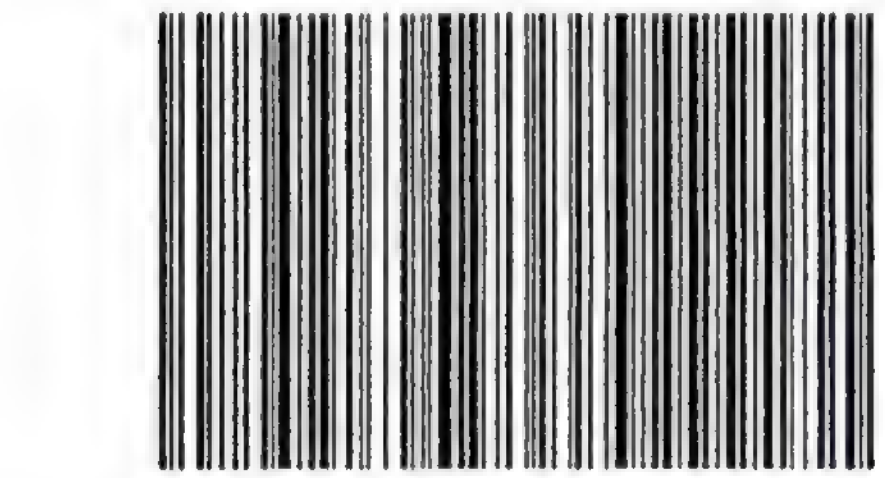

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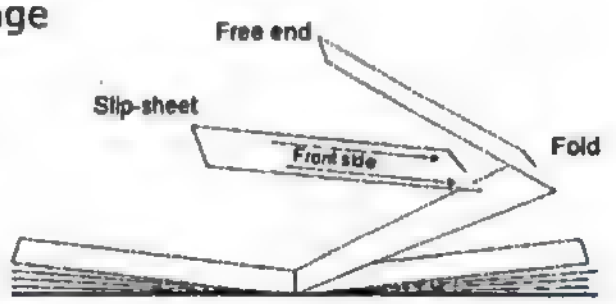

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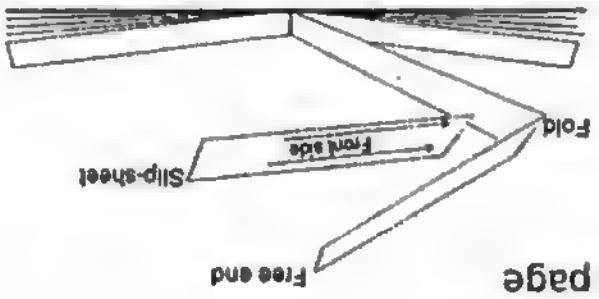

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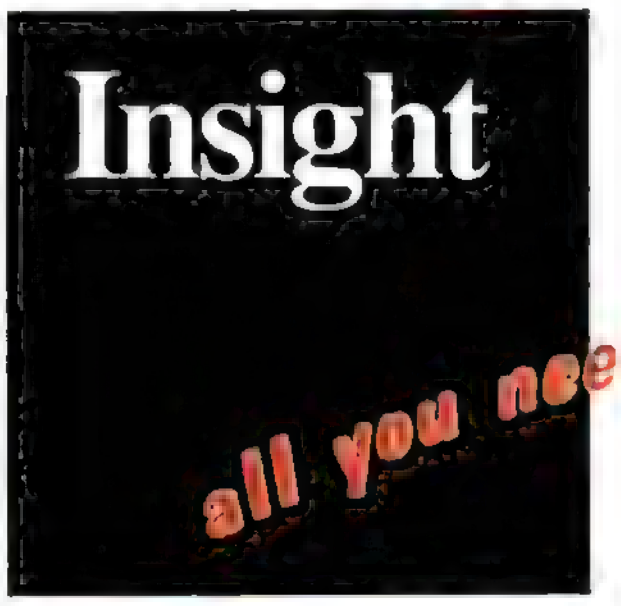

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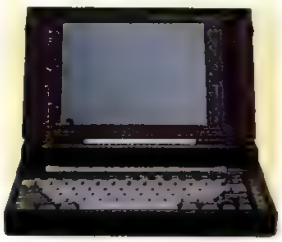

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ADVISOR

Shareware Sources: How to get shareware when you don't have a modem Upgrading Old Systems: Options for extending the utility of older PCs.

BY JOE SALEMI

Shareware Sources

PC Magazine frequently mentions shareware programs, but usually you only describe how to get copies of the programs by downloading them or contacting the author directly. I know there are a lot more shareware programs out there but I don't yet have a modem, so I can't call around to BBSs or PC MagNet to get them. Are there any other sources for finding out about and obtaining these programs?

Mike Bonadonna
Hawthorne, New Jersey

▶**PC MAGAZINE** A number of vendors publish catalogs of shareware, copyrighted-but-free, and public-domain software. These vendors usually price the programs by the disk. In some cases, a single program comes on multiple disks; in others, one disk contains multiple programs. You should be aware that if you purchase a disk containing a shareware program from these vendors, you'll get an unregistered, "try-before-you-buy" copy. You're still obligated to register the program with the author if you decide to continue using it after the trial period is over.

Reasonable Solutions (2101 W. Main St., Medford, OR 97501; 800-876-3475, 503-776-5777) publishes a small catalog that specializes in DOS and Windows utilities. The fee is $4 per disk for up to nine disks and $3.50 per disk if you buy more than ten disks at one time. (If you'd prefer 3.5-inch disks, the cost is an additional 50 cents per disk.)

A larger shareware catalog, put out by Public Brand Software (P.O. Box 51315, Indianapolis, IN 46251; 800-426-3475), also includes computer-related books. PBS generally charges $5 per disk and frequently runs specials that feature a number of related program disks at a lower price. When you do get a modem, you can sign up for a subscription ($50 per year) to Public Brand Software's BBS at 317-856-2087, which you can call for up to one hour each day and from which you can download the programs in the catalog. PBS, now owned by Ziff-Davis, is also a part of ZiffNet and the programs it carries are available in the new ZNT: PBSFORUM.

The largest catalog of shareware and public domain software is published by the Public (software) Library (P.O. Box 35705, Houston, TX 77235-5705; 800-242-4775, 713-524-6394). PsL charges $5 per disk ($6 each for 3.5-inch disks) and offers a number of different membership plans: You can automatically receive monthly updates of disks in a particular class (for example, programming utilities or utilities for Windows 3.0.), or get lower prices on bulk purchases. An annual subscription to the monthly *Public (software) Library* catalog costs $24. Through a special arrangement with a number of shareware authors, PsL is able to let you pay the registration fee for some programs at the time of purchase; this way, you get a fully registered copy of the program instead of the shareware version.

▶ IN THIS SECTION

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Laptops with CD-ROMs

I am looking for a portable computer rugged enough to be used in the field by utility repairmen. The catch is that the unit must incorporate CD-ROM technology in order to be effective. Any help you could give me in this area would be greatly appreciated.

Patrick W. Ellis
Chicago, Illinois

▶**PC MAGAZINE** You're in luck: A notebook-type computer with built-in CD-ROM has recently come on the market. The DynaVision III (Scenario Inc., 3 Bridge St., Newton, MA 02158; 617-965-6458), which weighs approximately 10 pounds, has a 20-MHz 386SX CPU, a 32-shade gray-scale VGA display that supports an external monitor, 2MB of RAM, a 20MB hard disk, a 1.44MB floppy disk drive, and a 350-ms 660MB CD-ROM drive that uses standard CD-ROM disks. The base system lists for $4,995.

Optional features for the DynaVision III include up to 6MB of RAM and up to 120MB in a single hard disk or 160MB with dual hard disks. An internal 2,400-bps fax/modem and internal Ethernet card are also available. The DynaVision is based on the Texas Instruments TravelMate 3000, so expansion options for the TI system should also work with it.

Upgrading Old Systems

Instead of replacing my IBM PC-XT, I'd like to upgrade it to 386 or 386SX capabilities. I already have a VGA graphics card and color monitor. Can you tell me what my options are?

Gerald K. Vick
New Hope, Pennsylvania

▶PC MAGAZINE Your best bet is to replace the motherboard with a new one that's based on a 386. You'll be able to continue using your existing peripherals until you upgrade them (particularly your hard disk) to match the capabilities of your "new" system. If the power supply in your system is the original 135-watt supply that came with the XT, however, it may not be capable of supporting the new motherboard. You'll want to upgrade it to at least a 200-watt version.

The 386N25 Motherboard, from Hauppauge Computer Works Inc. (91 Cabot Ct., Hauppauge, NY 11788; 516-434-1600), has a 25-MHz 80386DX CPU and supports up to 32MB on the motherboard. It comes in XT and "baby AT" form factors, with two 8-bit and six 16-bit ISA slots in the XT version, and lists for $819 with 1MB of RAM and a 32K memory cache. The 386N33 is similar, but has a 33-MHz 386DX and lists for $889 with 1MB of RAM and a 32K cache. Both boards have switchable bus speeds and will also support up to 128MB on the motherboard as 16MB chips become available.

Seattle Telecom & Data (2735 152nd Ave. NE, Redmond, WA 98052; 206-883-8440) sells the STD-386XT-16MHz for $995, the STD-386XT-20MHz for $1,195, and the STD-386XT-25MHz for $1,495. All three products come with 1MB of SIMM RAM installed, are expandable to 16MB, and have one 32-bit slot, four 16-bit slots, and three 8-bit slots.

American Megatrends Inc. (1346 Oakbrook Dr., #120, Norcross, GA 30093; 800-828-9264, 404-263-8181) is widely known as a vendor of BIOS chips for IBM compatibles. It also sells the AMI 386/486 Mark IV Screamer, a $900 40-MHz motherboard (based on the AMD 386-compatible chip) that comes with no RAM but supports up to 64MB of SIMM RAM. The board supports the Intel and Weitek coprocessors and has six 16-bit slots and two 8-bit slots.

Another 40-MHz replacement motherboard is the Privilege Gold 386-40C from Orchard Technology Inc. (45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; $599). It ships without any RAM installed but supports up to 32MB of SIMM RAM, and it has seven 16-bit slots and one 8-bit slot.

Finally, there is a series of replacement motherboards from ATronics International Inc. (1830 McCandless Dr., Milpitas, CA 95035; 800-488-7776, 408-942-3344) that all come with 1MB of SIMM RAM installed. The ATI 2000/BX 386SX ($350) has a 16-MHz 386SX, supports up to 4MB of RAM on the board, and has six 16-bit and two 8-bit slots. The ATI 386/B2-25 ($400) has the same slot configuration but has a 25-MHz 386DX CPU and supports up to 8MB of RAM on the board. The ATI 386/B2-33 ($450) has a 33-MHz 386. Finally, the ATI 386/B2-40, which also uses the AMD 40-MHz 386, lists for $460. All the ATI motherboards except the 386SX version support Intel and Weitek math coprocessors. The 386SX only supports the Intel 80387 chips designed for use with the SX chip.

Printing to a File

The Print Scrn key prints the contents of the screen to the attached printer. What I really need to do, however, is "print" the contents of one or more screens to a file. Is there a way that I can do this in DOS?

R. A. Sobieraj
Perth Amboy, New Jersey

▶PC MAGAZINE There's no way to do it directly from DOS, but some TSR (terminate and stay resident) utilities let you redirect printer output to a file. PRN-2FL.COM, which appeared in the December 22, 1987, issue of *PC Magazine*, redirects all printer output to the file name you choose. You can download a copy from Library 2 (PCMag Utils) of the Utilities/Tips Forum on PC MagNet. Another utility available from PC MagNet is SNIPPER, which lets you copy all or part of the screen either to the printer or to a file for later use.

A commercial program for capturing screens is Collage Plus Publishing Utilities (Inner Media Inc., 60 Plain Rd., Hollis, NH 03049; 800-962-2949, 603-465-3216; $129), which lets you store screenshots of text or graphics screens to a file or print them. Output files can be stored in text, .PCX (PC Paintbrush), TIFF, or Windows 3.*x* .BMP formats. Versions of Collage are available for Windows 3.0 ($129) and OS/2 ($199). All versions allow you to view the saved screenshots.

New Lives for Old Systems

Recently my company began buying new computers to replace our older XTs and ATs. There's nothing wrong with the older systems, but we found that they just don't have the horsepower to run most of today's software. We'd hate to see these older systems go to waste just sitting in a storeroom or worse yet, tossed out as trash. Do you have any suggestions on what we can do with them?

Dave Teeple
Deerfield Beach, Florida

▶PC MAGAZINE You can donate the "retired" computers to your local school system. Many schools don't have the budget to provide computer training for their students and will probably welcome any equipment they can get.

Another suggestion is to contact the not-for-profit National Cristina Foundation (42 Hillcrest Dr., Pelham Manor, NY 10803; 800-274-7846, 914-738-7494). The Foundation is dedicated to spreading modern technology to those with disabilities, the disadvantaged, and students who need remedial help. The National Cristina Foundation accepts computer systems, software, and peripherals, and provides documentation on the value of the donated equipment that is acceptable to the IRS for tax purposes. (Check with your accountant for further details on deducting donated equipment.)

Correction

The Advisor column in the February 25, 1992, issue included the wrong area code for Logitech's BBS. A new area code was assigned in the San Francisco area in late 1991, so the correct number is 510-795-0408. □

ASK THE ADVISOR

Send your question to PC Advisor, One Park Ave., New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 12 of this issue). We regret that we are unable to acknowledge submissions or answer letters individually.

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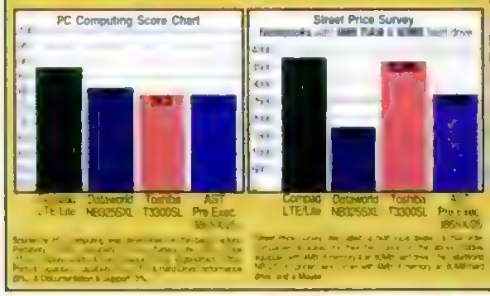

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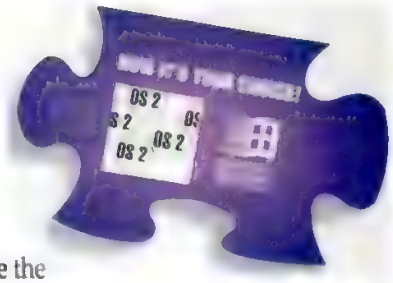

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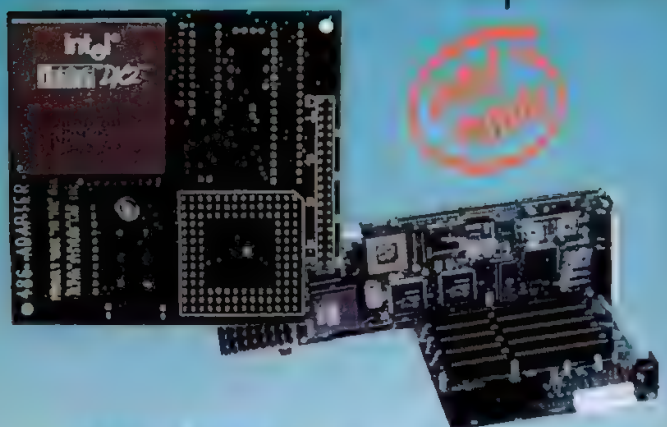

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TUTOR

UMBFILES and Memory Managers: Using this utility with QEMM-386 and 386Max Understanding EXE2BIN: Why this utility isn't useful for everyone.

BY JEFF PROSISE

UMBFILES and Memory Managers

Several readers have contacted me on PC MagNet to ask if my UMBFILES utility, which appeared in *PC Magazine*'s November 26, 1991, Utilities column, can be used with Quarterdeck's QEMM-386 and Qualitas's 386Max memory managers. It can, if you have the latest release of your chosen memory manager (QEMM-386, Version 6.0, or 386Max, Version 6) and you're currently running DOS 5.0. You'll need to make a minor configuration change first, though.

UMBFILES increases the largest executable program size under DOS 5.0 by moving most of the system file table (the data structure in which DOS stores information about open files) to upper memory. To use it with QEMM-386 6.0 (or QRAM, Version 2.0, Quarterdeck's QEMM-like memory manager for non-386s), you must add the statement DOS=UMB to CONFIG.SYS. (If your CONFIG.SYS contains the statement DOS=HIGH, replace it with DOS=HIGH,UMB rather than adding another line.)

Why the change? When you specify DOS=UMB, DOS 5.0 assumes control of the UMBs created by the upper memory manager, making them available to application programs via the operating system's memory management API (application program interface). Specifically, DOS can allocate UMBs it controls to programs that call its function 48h.

Without the DOS=UMB statement, DOS answers the request from a program with an error code claiming no UMBs are available. UMBFILES uses function 48h to allocate a UMB for the system file table, though. If CONFIG.SYS lacks the line DOS=UMB, UMBFILES can't allocate the memory it needs.

When you specify DOS=UMB, DOS sets up a chain of MCBs (memory control blocks) in upper memory similar to the ones it sets up in low memory. Fortunately, this has no appreciable impact on QEMM-386. The product's LOADHI utilities (LOADHI.COM and LOADHI.SYS) recognize the situation and adjust the methods they use to load TSRs and device drivers high.

Specifying DOS=UMB also gives you the option of using DOS 5.0's LOADHIGH and DEVICEHIGH commands to load TSRs and device drivers, although there's no obvious reason to use DOS's commands in place of QEMM-386's more powerful LOADHI.COM and LOADHI.SYS.

386Max doesn't like the DOS=UMB statement, but there's another way to configure Version 6 (or BlueMax) for compatibility: the undocumented DOS5 switch. Loading 386MAX.SYS with a DOS5 switch in your CONFIG.SYS makes UMBs managed by 386Max available through DOS function 48h, enabling UMBFILES to acquire the memory it needs. Don't look for this in the 386Max Reference Guide; it's not mentioned. Perhaps Qualitas will document it in a future release.

If you don't have Version 1.2 of UMBFILES, you can download UMBFIL.ZIP from Library 2 (PCMag Utils) of the Utilities/Tips Forum on PC MagNet. Or send us a postcard with your name and address and we'll send it to you on-disk. Version 1.1 fixed a subtle problem that caused the MEM /C command to report erroneously the amount of upper memory reserved for DOS. Version 1.2 eliminates a bug that sometimes caused system crashes if UMBFILES was unable to allocate a sufficient amount of upper memory for itself. Also, UMBFILES now appears in the upper memory section of the report generated by the MEM /C command; it didn't in Version 1.0.

One final note regarding the interaction between UMBFILES and Windows: Some users report that Windows will not start in 386 Enhanced mode unless FILES= is set to 10 or above. The problem is not universal; I haven't been able to duplicate it. Nor is it unique to UMBFILES. Some QEMM-386 users report the same problem with Quarterdeck's FILES.COM utility, which, like UMBFILES, relocates the system file table to upper memory. If you experience a similar problem, try increasing your FILES= setting by increments of 1 or 2 until you arrive at a value that works.

Deleting Files with Spaces

When saving a program recently, I inadvertently put a space in the name, which DOS willingly accepted. The file shows up when I type DIR, but I can't edit or delete it. It's large, so I'd like to get rid of it. But how?

Bernardo Bacic
New South Wales, Australia

▶**PC MAGAZINE** Deleting a file with a space in its name is the oldest trick in the book, but one that bears repeating. The file functions in the DOS kernel let programs create files with spaces in their names. COMMAND.COM, however, uses the space character as a *delimiter* (a character that separates parameters on the command line). If you try to delete a file named SPC FILE by typing:

```
DEL SPC FILE
```

COMMAND.COM will think you're trying to remove two files: SPC and FILE. In DOS 5.0, you'll receive the error message "Too many parameters" and the file will remain unaffected.

To delete a file containing a space in its name, use the ? wildcard character. To erase SPC FILE, for example, type:

```
DEL SPC?FILE
```

Be careful that no other files exist that match this specification. If you have DOS 4.0 or later, you can avoid accidental deletions by using the DEL command's /P switch to have DOS prompt you for verification before deleting each file.

The DOS Clock

On January 1 of this year, we discovered that the internal clock on our Olivetti M24 PC had wrapped around to January 1, 1984, apparently because December 31, 1991 was the highest it could go. A local dealer supplied us with a device driver called CLOCK.SYS that corrects the deficiency, presumably by replacing the DOS CLOCK$ device driver. Now I'm curious about CLOCK$. Can you please explain how and when DOS uses the driver, as well as the format of the data passed to it?

R. E. Zobell
Calgary, Alberta, Canada

▶PC MAGAZINE CLOCK$ is one of the resident device drivers DOS installs each time it starts, along with NUL, CON, PRN, and others. CLOCK$ provides the interface between DOS and the system's real-time clock, which is responsible for maintaining a record of the current date and time. Bit 3 (the CLOCK bit) in the driver's device attribute word identifies the system's clock device driver, just as bit 4 identifies the console device (CON), bit 2 identifies the NUL device, and bits 1 and 0 identify the standard output and standard input devices, respectively.

DOS uses the CLOCK$ driver anytime it needs to get or set the current date or time. The DOS Get and Set System Date functions (2Ah and 2Bh) invoke the CLOCK$ driver, as do the Get and Set System Time functions (2Ch and 2Dh). DOS also consults CLOCK$ when it needs the current time and date to stamp a directory entry. Additionally, CLOCK$ is called when you execute DATE or TIME from the command line.

Format of the CLOCK$ Data Packet

Figure 1: **DOS communicates with the CLOCK$ device driver using the 6-byte data packet with the format shown here.**

DOS communicates with the CLOCK$ driver using the 6-byte data packet diagramed in Figure 1. The first two bytes designate, in low byte/high byte format, the number of days that have elapsed since January 1, 1980. Bytes 2 through 5 specify the current time in minutes, hours, hundredths of seconds, and seconds.

DOS sets the time and date by formulating a data packet and sending it (via direct calls to the driver's strategy and interrupt routines) to the CLOCK$ driver. Conversely, to read the current time and date, the system reads a data packet from the driver, converting the values it receives into a calendar date and hours, minutes, and seconds.

Understanding EXE2BIN

In an attempt to shrink some of the .EXE files on my hard disk, I tried converting them to .COM format using EXE2BIN, but it replied that the files could not be converted. Why not?

Khia Nou
Boston, Massachusetts

▶PC MAGAZINE Most PC users aren't even aware that EXE2BIN exists. Fewer still understand what it does. Here's the lowdown on the mysterious command and why it's only useful to programmers.

Since Version 1.0, DOS has supported two executable file formats: .COM and .EXE; .COM is the simpler of the two. Executable files with a .COM extension appear in memory exactly as stored on-disk. To load a .COM file, DOS builds a PSP (Program Segment Prefix)—a 256-byte data structure that it places in front of every program it loads and executes. After setting all four segment registers to the segment of the PSP, DOS reads the program image from disk into memory just above the PSP. It then sets the *IP register* (instruction pointer register, which holds the address of the next CPU instruction to fetch and run) to 100h and executes the code.

To make the uncomplicated load-and-execute process possible, .COM programs must fit several criteria. They can contain only one code segment, and the first executable instruction must appear at offset 100h. By contrast, an .EXE file may contain multiple segments and the starting point (designated by initial values for CS:IP stored in the .EXE file header) may be anywhere in the program. Also, a .COM file can run without modification no matter where it's loaded in memory. DOS alters certain parts of an .EXE-formatted program when it's loaded to resolve references to addresses in memory that are not defined until the program is loaded.

The bottom line is that EXE2BIN will only convert an .EXE file to a .COM file if the .EXE file meets the stringent requirements of the simpler .COM format. Most .EXE files do not.

DOS includes EXE2BIN so that programmers may convert their .EXE files into .COM files—provided, of course, that they wrote their programs to fit the .COM format. EXE2BIN is of little or no use to nonprogrammers, though. It's one of those obscure DOS utilities that the vast majority of PC users will never have a need for but that certain people couldn't do without. □

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine,* One Park Ave., New York, NY 10016, or upload them to PC MagNet (see page 12 for instructions). We regret that we cannot acknowledge submissions or answer questions individually.

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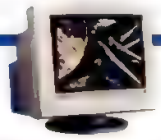

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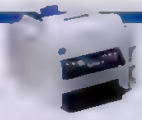

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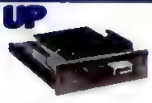

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NE 3200	669
Access Server	1595

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USER-TO-USER

Removing Subdirectories: Prune branches from your directory tree Eliminating the Microsoft Logo: The last word on getting rid of the logo

BY NEIL J. RUBENKING

Copying the Volume Label

I often have to transfer original 5.25-inch program disks to 3.5-inch disks for installation on a PS/2, laptop, or other machine without a 5.25-inch drive. Since many installation programs check the disks' volume labels during the process, I used to have to copy these by hand.

There's no single command to copy a volume label, so I wrote the batch program VCOPY.BAT (Figure 1) to handle it. You only have to insert a source 5.25-inch disk in drive A: and a blank target 3.5-inch disk in drive B: and type the command VCOPY; the files and volume label will be copied automatically.

There is a limit: The original volume label cannot contain more than five space characters. Any characters after the fifth space will be ignored. In such a case, you would have to add the volume label by hand.

Chan Chung Yuen
Hong Kong

▶PC MAGAZINE This clever batch file first calls XCOPY with the /S and /E switches to copy everything from drive A: to drive B:, including the full subdirectory structure. It assumes that drive B: is large enough to hold this data; you *could* get into trouble if you tried using VCOPY to copy a 1.2MB 5.25-inch disk to a 720K 3.5-inch disk.

After copying the file and subdirectory data, VCOPY builds another batch file called VOLUME.BAT by redirecting ECHO commands into that file. You might want to create VOLUME.BAT *once* and keep it in your BAT directory instead. It looks like this:

```
@echo off
IF '%4'=='has' goto end
label b:%5 %6 %7 %8 %9
:end
```

DOS converts pairs of percent signs to single percent signs when processing batch file lines, so the ECHO commands that create the second and third lines of VOLUME.BAT use double percents.

Next, VCOPY calls VOL to display the volume label of the disk in drive A: for the user's benefit and then calls VOL again, this time piping its output through the FIND filter and redirecting only the line containing the word *drive* to the file GO.BAT. (If the disk was formatted under DOS 4.*x* or 5.0, VOL also returns the disk serial number; FIND filters out that extra line.) GO.BAT will either contain "Volume in drive A has no label" or a line that says something like "Volume in drive A is LEP GEX VEN".

The next line calls the newly created file GO.BAT, which has the effect of calling VOLUME.BAT. If the disk in drive A: had no label, the fourth parameter is *has* and VOLUME.BAT exits. The original VCOPY had VOLUME.BAT test whether the fifth parameter was *no*; I changed it to avoid a potential problem. DOS's LABEL command forces volume labels to uppercase, but with third-party label utilities or even DEBUG you can set a lowercase label. As first written, VCOPY would have failed on a disk labeled "no problem". Note also that the label on the target disk *will* be forced to uppercase.

If the source disk did have a label, the next line in VOLUME.BAT assigns that same label to drive B:. That label will be uppercase regardless of the case of the original, and multiple spaces within the original label will not be preserved in the copy. The reason you can't have more than five separate spaces within the label is that the label starts at parameter %5, and batch files only support parameters through %9. That limitation doesn't create any problems, though, because a label can't have more than five separate spaces anyway. Such a label would look like `"X X X X X"` and that's 11 characters, which is the maximum length for a label.

VCOPY.BAT
Complete Listing

```
@off
xcopy a:\ b:/s /e
echo @echo off> volume.bat
echo if '%%4'=='has' goto end>> volume.bat
echo label b:%%5 %%6 %%7 %%8 %%9>> volume.bat
echo :end>> volume.bat
vol a:
vol a: | find "drive" > go.bat
call go
vol b:
del volume.bat
del go.bat
```

Figure 1: This batch file will copy a 5.25-inch disk in drive A: to a 3.5-inch disk in drive B:. The copy will include the volume label.

Removing Subdirectories

Removing a whole subdirectory on your hard disk can be a tedious chore, especially if it contains a lot of branches. I haven't seen any DOS batch files that will do the job automatically. In fact, it's extremely difficult to write one to do any repetitive task across different subdirectories, because the batch file has no way of determining the subdirectory names at runtime.

Fortunately, DOS 5.0's DIR command provides a solution. With the two

PD.BAT

Complete Listing

```
@echo off
if %1/==/ goto Syntax
if %z%/==/ goto Syntax
::
REM Create a file containing the name of this batch
REM file followed by the directory on which it was
REM invoked, a backslash, and a Ctrl-Z character.
::
echo %0 %1\%z% >%1\ch.$$$
::
REM Create a file listing the subdirectories of the
REM directory on which this batch file was invoked
::
dir %1 /a:d/b >%1\lf.$$$
::
:loop               ;over all dirnames
::
copy %1\lf.$$$ %1\df.$$$ >nul
::
REM If there are no more subdirectories to deal with,
REM delete all files and this directory.
::
if not exist %1\df.$$$ goto cut
::
REM Create a temporary batch file that will re-invoke
REM PD.BAT on a subdirectory of the current directory.
::
copy %1\ch.$$$+%1\df.$$$ %1\x.bat >nul
::
REM Filter out the line that handles the first of the
REM subdirectories in the list, and store the result
REM as the list of remaining directories.
::
type %1\x.bat | find /v ''%0 %1'' > %1\lf.$$$
::
REM Make a recursive call to this batch file, to delete
REM all files and subdirectories in one particular
REM subdirectory.
::
call %1\x
goto loop
:cut                ;cut-off branch
echo Pruning directory %1
::
REM Turn off the read-only and hidden attributes for
REM all files in the directory; leave the system attribute
REM so there's no chance of deleting the system files.
::
attrib -r -h %1\*.*
echo y | del %1 >nul
rd %1
goto end
:Syntax
echo PD.BAT - Prune Directory
echo SYNTAX:  SET z=^Z
echo          PD [[drive:\]path\]dirname
:end
```

Figure 2: **This recursive batch file erases all files and directories in or below the directory you pass to it.**

switches /a:d and /b, DIR displays a bare listing of all the subdirectories of the current directory. I wrote PD.BAT (Prune Directory, shown in Figure 2) as a utility to get rid of unwanted branches in my directory tree.

Running PD.BAT is actually a two-command process. The environment variable z *must* be set to Ctrl-Z at the DOS prompt prior to calling PD.BAT the first time. This isn't necessary in subsequent calls unless the computer is rebooted. The format is

```
SET Z=^Z
PD [[drive:\]path\]dirname
```

where dirname is the name of the directory to be pruned. Invoked without any parameters, PD displays the command syntax. The current directory should not be at or under the directory to be pruned.

PD.BAT is a recursive routine. It works with one directory at a time and calls itself as many times as there are child directories. Except for the system files, the files in the root directory may be erased, so care must be taken if the current drive is the boot drive. The root directory itself cannot be removed.

The output of the command `DIR /a:d/b` is first redirected to a temporary list file LF.$$$. Each of the directory names in this list is then accessed by making them parameters to a batch file. This is done by prefixing the batch-file name and directory contained in CH.$$$ to the file LF.$$$ and saving the result as a second batch file, X.BAT. This file is then rewritten to a new list file, LF.$$$, but the first line is filtered out. When X.BAT is called, it immediately transfers control to PD.BAT, with the new directory name as the first parameter. This procedure is repeated for the new list file until the list file is empty; then PD deletes all files in the directory and removes the directory itself.

PD.BAT is not as fast as *PC Magazine*'s PRUNE.COM utility, but it does the job well. And for half a kilobyte of disk space, you probably won't mind keeping it in your collection.

Arneil P. Reyes
Los Alamos, New Mexico

▶PC MAGAZINE PD is a powerful batch file, no question about it. I felt, though, that it shouldn't have the unfettered power to wipe out a whole disk partition, so I wrote the "wrapper" batch file shown in Figure 3, PDWRAP.BAT, to add some error trapping to PD.BAT.

PDWRAP makes a number of tests on the directory name you pass to it. First it makes sure you haven't passed a root directory, the current directory (.), or the parent of the current directory (..). It does this using a quirk of the DOS FOR command. (This quirk was explained in detail in the User-to-User column of July 1992.) Each of the three FOR commands trims the first character from the environment variable theDir but doesn't reduce it to

PDWRAP.BAT

Complete Listing

```
@ECHO OFF
IF '%1'==''  GOTO Syntax
SET theDir=%1
FOR %%v IN (/%theDir%) DO SET theDir=%%v
FOR %%v IN (/%theDir%) DO SET theDir=%%v
FOR %%v IN (/%theDir%) DO SET theDir=%%v
IF '%theDir%'=='.' GOTO BadChoice
IF '%theDir%'=='\' GOTO BadChoice
IF NOT EXIST %1\NUL GOTO NoDirectory
PD %1
:BadChoice
ECHO You must not attempt to prune the current
ECHO directory, its parent, or any root directory!
GOTO End
:NoDirectory
ECHO Directory ''%1'' does not exist
GOTO End
:Syntax
ECHO SYNTAX : PDWRRAP [[drive:\]path\]dirname
:End
SET theDir=
```

Figure 3: **This batch file wraps the PD batch file (Figure 2) with safety tests, preventing you from accidentally using PD on the current directory, its parent, any root directory, or any nonexistent directory.**

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less than one character. If the passed directory name was three characters or fewer and ended in a backslash or a period, PDWRAP rejects it.

Next PDWRAP checks whether the directory exists by testing for the existence of the NUL device in that directory. You should note that this common test for directory existence will not work with DR DOS, nor with certain network operating systems.

If the directory is acceptable, PDWRAP passes it along to PD.BAT. These extra steps could save you from accidentally erasing a lot more than you intended to. I strongly suggest you do *not* run PD.BAT without its safety wrapper. And before you press Enter to activate even PDWRAP, you should think twice about whether you'll ever want to see those files again!

As for the inner workings of PD.BAT, I tried to clarify them by adding copious comments, but I think that a couple of points deserve special mention. PD needs the environment variable Z set to the value ^Z, because if DOS encounters an actual ^Z character in a batch file, it assumes that's the end of the file. PD uses the Z variable to create a temporary file containing PD, the name of the directory on which it's working, and a backslash, but no carriage return. This is the CH.$$$ file; it actually does have a carriage return, but it comes after the ^Z and is ignored. You may find some other uses for this technique.

PD loops through all the lines in the list of directories by prefixing the line from CH.$$$ to the *first* line in the list and then filtering the result with FIND in order to strip out that line. The result goes back into the list of directories, and the next time the loop processes the next directory. You can learn a lot from this masterful batch file; you'll probably want to study it thoroughly before turning it loose on your directory tree.

Eliminating the Microsoft Logo

Regarding Dean Yorke's tip in the February 25, 1991, Windows column, I use an even simpler approach to get rid of the Microsoft logo when starting Windows. The Windows SETUP program builds WIN.COM from WIN.CNF, VGALOGO.LGO, and VGALOGO .RLE. It doesn't care whether those VGALOGO files are in their original state, so I simply overwrote both files with zero-length files of the same name. Now I can repeatedly change screen drivers without recopying WIN.CNF to WIN.COM after every change.

Daniel F. Heygel
Basel, Switzerland

▶**PC MAGAZINE** About 80 percent of the Windows tips submitted by *PC Magazine* readers relate to eliminating the initial Microsoft logo. Unfortunately, most repeat the same few ideas. Mr. Heygel's is one of the few with a new approach. In hopes of putting this topic to rest *permanently,* let's review the common suggestions:

- *Start Windows with WIN : (WIN followed by a space and a colon).* Rumors have Microsoft technicians faulting this incredibly simple solution for leaving Windows in an "unstable state," but I've confirmed with the Windows team that those rumors are incorrect. There's no technical problem with this solution, and no reason to use any other solution.
- *Patch WIN.COM, changing LOGO to logo.* This patch only saves the fraction of a second required to actually display the bitmap. Each time you run SETUP, you have to apply the patch again.
- *Copy SYSTEM\WIN.CNF directly to WIN.COM.* This technique shrinks WIN.COM by the size of the RLE bitmap and the LGO file, but you must recopy WIN.CNF to WIN.COM after each time you run SETUP. Problems have been reported when using this method on a dual-monitor system.
- *Replace VGALOGO.RLE and VGALOGO.LGO with 0-byte files.* This has the same effect (and the same possible problems) as the previous suggestion, except you don't have to repeat it each time you run SETUP.
- *Replace VGALOGO.RLE with the RLE file of your choice.* The RLE file must be in the RLE 4 format (16 colors) and it must be small enough that the resulting WIN.COM doesn't go over 64K in size.

None of the standard Windows auxiliary programs can produce RLE bitmaps. For those who want to experiment, the DEBUG script VGALOGO.SCR shown in Figure 4 produces a totally minimal RLE bitmap. Before you use it, be sure to rename your original VGALOGO .RLE, perhaps to VGALOGO.OLD. Redirect the script into DEBUG with the command

```
DEBUG < VGALOGO.SCR
```

to generate a new VGALOGO.RLE. To incorporate the new file into WIN.COM, simply run SETUP and then make a change to any of the items. You can download the files VGALOGO.SCR and VGALOGO.RLE from PC MagNet as VGALOG.ZIP.

One big question still remains: Why bother? There is no appreciable time savings; instead of staring at the logo while Windows loads, you'll just end up staring at a blank screen. □

VGALOGO.SCR
Complete Listing

```
NVGALOGO.RLE
RCX
7C
F CS:100 L 7C 0
E CS:100 'BM' 1F
E CS:10A 76
E CS:10E 28
E CS:112 01
E CS:116 01
E CS:11A 01 00 04 00 02
E CS:122 04
E CS:176 01
E CS:179 01
W
Q
```

Figure 4: **Redirecting this script into DEBUG produces a minimal RLE bitmap to replace the Windows startup logo. Be sure to back up the existing VGALOGO.RLE before using the script.**

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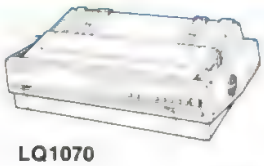

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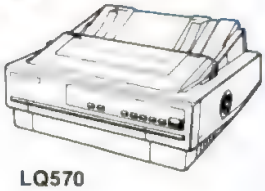

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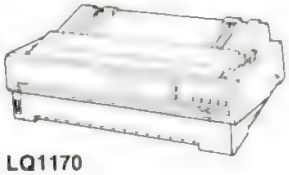

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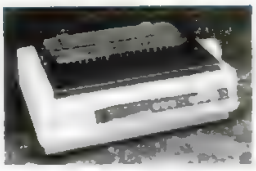
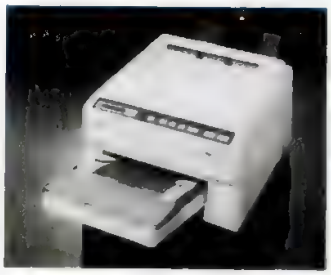
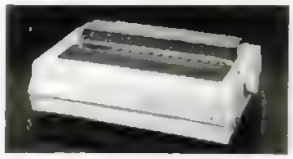


2123



4410-5 PPM



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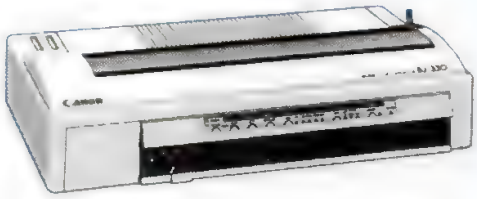

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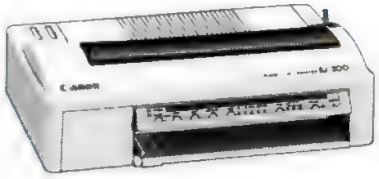

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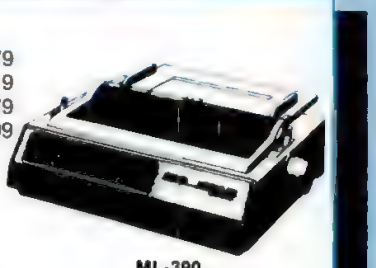

ML-390

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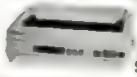

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SPREADSHEETS

Icons for Excel Files: A macro that uses DDE to create Program Manager icons for your files from within Excel.

BY CRAIG STINSON

Icons for Excel Files

I often use Microsoft Excel for projects that last an extended period of time. To speed up repeated access to these project files, I used to create program items manually in Windows' Program Manager. Then I would just double-click these icons to launch Excel and automatically load the files I needed.

Most of the time I created my program items with Program Manager's File New command. Occasionally, I did it by dragging an icon from a File Manager directory window to a program group in Program Manager. Either way, the process seemed unnecessarily awkward to me. Why shouldn't the application itself give you the option of creating start-up icons for its documents?

Using the Program Manager DDE commands AddItem and CreateGroup, I wrote the add-in macro shown in Figures 1 and 2. Now, whenever I'm working on an Excel file that I know I'm going to be returning to, I can create a start-up icon for it without leaving Excel.

When opened or installed in Excel's start-up directory, this macro adds a Save As Icon command to Excel's File menu. When invoked, Save As Icon first saves the active document to disk and then automatically creates a program item by sending the appropriate DDE commands to Program Manager.

If the active document has never been saved, the macro first displays a standard File Save As dialog. If the document has been saved but has been changed since its most recent save, a standard File Save is performed. This ensures that an up-to-date version of the file exists on-disk before the program item is created. Canceling out of the File Save As dialog box halts the macro and returns the user to the active document.

Once the file is safely on-disk, a new dialog box prompts for icon and group names. By default, the icon name is set to the filename, but this may be overridden. The group name can either be that of an existing group or that of a new group to be created by the macro. If the OK button is clicked before both values are entered, an alert message is displayed and the macro ends with no further action. The macro also ends if the user clicks the Cancel button.

After the dialog box is completed and the OK button is clicked, the macro initiates a DDE conversation with Program Manager. The specified program group is selected (or created), and the item is added. The properties of the resulting program item will be as follows: Description—the icon name entered into the dialog box; Command Line—the complete path and filename of the active document; Icon—EXCEL.EXE. Note that the assumption is made that EXCEL.EXE is in the DOS search path. If it is not, one of the default Program Manager icons will be used instead of the Excel icon.

Frank Reidelberger
Des Plaines, Illinois

SAVIC4.XLA A1:D29

1 of 2

	A	B	C	D
1	*names*	commands	comments	
2				
3		mco00.AutoOpen		
4	*auto_open*	=ADD.COMMAND(1,"File",um01.AddInMenu,"Save Workbook...")	*add command to menus*	
5		=ADD.COMMAND(2,"File",um01.AddInMenu,"Save Workbook...")		
6		=ADD.COMMAND(5,"File",um01.AddInMenu,7)		
7		=ADD.COMMAND(6,"File",um01.AddInMenu,7)		
8		=RETURN()		
9				
10	*mcp01 SaveAsIcon*	mcp01.SaveAsIcon		
11		=IF(mcs01.SaveFile(),,RETURN())	*Save document or RETURN.*	
12		=SET.VALUE(ud01s.Title,GET.DOCUMENT(1))	*Set Icon title default to filename.*	
13		=SET.VALUE(ud01s.Group,"")	*Clear group name.*	
14	*mcp01n.Dialog*	=DIALOG.BOX(ud01.GetInput)	*Display dialog box, get input.*	
15		=IF(mcp01n.Dialog<>1,RETURN())	*If user CANCELed then RETURN.*	
16		=IF(AND(ud01s.Group<>"",ud01s.Title<>""))	*If both GROUP and TITLE entered*	
17		= mcs02.AddIcon()	*add icon to ProgMan*	
18		=ELSE()	*else*	
19		= ALERT("Both an Icon Title and a Group must be entered",3)	*alert user to need for both.*	
20		=END.IF()		
21		=RETURN()		
22				
23	*mcs01 SaveFile*	mcs01.SaveFile		
24		=IF(ISNA(GET.DOCUMENT(2)))	*If document has not been saved*	
25		= IF(SAVE.AS?(),,RETURN(FALSE))	*do SAVE.AS or RETURN*	
26		=ELSE()	*else*	
27		= IF(GET.DOCUMENT(4),SAVE())	*If document is dirty, save it.*	
28		=END.IF()		
29		=RETURN(TRUE)		

Figure 1: **The first range of an Excel 4.0 macro that creates a Windows Program Manager icon for any Excel file.**

SAVIC4.XLA A30:D45

2 of 2

30			
31	*mcs02 AddIcon*	mcs02.AddIcon	
32	*mcs02s itemFile*	=GET.DOCUMENT(2)&"\"&GET.DOCUMENT(1)	*Build complete pathname*
33	*mcs02n.ChanNum*	=INITIATE("Progman","Progman")	*Open DDE channel to ProgMan*
34		=EXECUTE(mcs02n.ChanNum,"[CreateGroup("&ud01s.Group&")]")	*Choose/create group*
35		=EXECUTE(mcs02n.ChanNum,"[AddItem("&mcs02s.itemFile&","&ud01s.Title&",EXCEL.EXE)]")	*Add item to group*
36		=TERMINATE(mcs02n.ChanNum)	*Close DDE channel*
37		=RETURN()	
38			
39		mcx00.AutoClose	
40	*auto_close*	=DELETE.COMMAND(1,"File","Save as Icon...")	*delete commands from menus*
41		=DELETE.COMMAND(2,"File","Save as Icon...")	
42		=DELETE.COMMAND(5,"File","Save as Icon...")	
43		=DELETE.COMMAND(6,"File","Save as Icon...")	
44		=RETURN()	
45			

SAVIC4.XLA E1:M16

Partial Listing

	E	F	G	H	I	J	K	L	M
1	UDMs								
2	Command	Macro	Key	Status Bar Text	Help	*Names*			
3									
4	Save as &Icon	mcp01.SaveAsIcon		Save document as icon in Program Manager		*um01.AddinMenu*			
5									
6	UDDs								
7	type	x	y	w	h	text	int result	*names*	
8									
9				300	100		5	*ud01.GetInput*	
10	3	200	10	88		&OK			
11	2	200	35	88		&Cancel			
12	5	15	10			Save as &Icon			
13	5	15	50			in &Group			
14	6	13	25	165			SAVIC4.XLA	*ud01s.Title*	
15	6	14	65	165				*ud01s.Group*	
16									

Figure 2: **The second range of SAVIC.XLA, presented here, defines the macro's custom command and dialog box.**

▶PC MAGAZINE Mr. Reidelberger's macro presents the simple dialog box shown in Figure 3. Most of the time, you can leave the top half of the dialog box, accepting the current filename as the name of your new program item. But you'll have to fill out the bottom half each time you use the command. Be careful to type the name of your program group correctly. If the group is called Excel4.0, for example, don't spell it Excel 4.0 (with a space), Excel40, or XL4—or your Program Manager window will be cluttered with new program groups.

Because the macro doesn't check to see whether you already have a program icon for the current file, you'll want to use it only once per file. Otherwise, you'll have to contend with a proliferation of identically named (and identically functioning) program items.

As shown in Figures 1 and 2, the macro runs in Excel 4.0. If you're recreating it for Excel 3.0, you need to make two substitutions. In cells B4 and B5, change "Save Workbook..." to "Save Workspace...". If you're downloading it from PC MagNet, use the name SAVIC3.XLA for Excel 3.*x* and SAVIC4.XLA for 4.0.

Figure 3: **This dialog box is presented by the icon-creating macro.**

Mr. Reidelberger's comments in column C seem self-explanatory, so I won't elaborate. I will comment briefly on his range names, however. The macro follows (with some modifications) a set of reference-naming conventions that was established several years ago by Excel developer Will Tompkins. This naming system is one aspect of a methodology for organizing Excel macros, known as the *EDJ* methodology—after the name of the journal in which Mr. Tompkins first published his system. Because the EDJ methodology encourages disciplined programming, Microsoft is actively supporting it and will feature it in Excel courses at Microsoft University beginning late this year.

Identifiers in the EDJ system have four components: an origin type, a sequence number, a reference type, and a text name. In `mcpØ1n.Dialog`, for example, `mcp` is the origin type, `Ø1` is the sequence number, `n` is the reference type, and `Dialog` is the text name. The origin type (for example, `mcp`, which stands for *macro command primary*) identifies the function of the name in the overall structure of the macro. The sequence number identifies the order in which names of a particular origin type were entered. The reference type (sometimes omitted) indicates whether the name is assigned to a cell, a range, an array, or some other category. And the text name is a plain-English descriptor.

Those heavily prefixed names can be intimidating when you first see them on the macro sheet, but they pay big dividends in the form of reduced debugging and maintenance time. I'll have more to say about the EDJ methodology later. □

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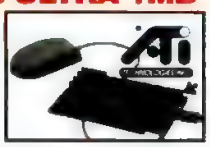

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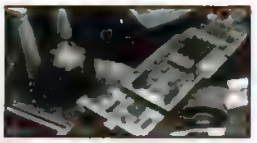

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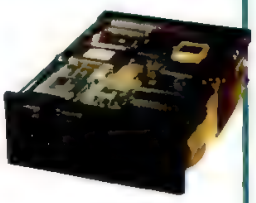

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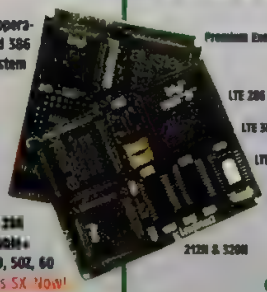

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THE WORKING WORD

Temporary Formatting Changes: How to include a section of text with different tab and format settings in a WordPerfect document

BY M. DAVID STONE

Temporary Formatting Changes

The obvious way to change tab settings for a short section of text within a WordPerfect document is to go to the beginning of the section, enter the tab settings for the section, then go to the end of the section and enter another code to redefine the tabs back to their original settings. However, it's far more efficient to enter the tab settings at the end of the section first. Go to the end of the section and hit Shift-F8, Line, Tab, F7, F7. This will enter the tab settings currently in effect. Then return to the beginning of the section to define the new tab settings for the section itself.

William J. Wolfe
Champaign, Illinois

▶**PC MAGAZINE** This elegant little timesaver works as described in WordPerfect 4.2, 5.0, and 5.1, but not in WordPerfect for Windows.

With WordPerfect for Windows, you have to make a change in the Tab Set dialog box, or else the program will not enter the tab settings in the document. The change, however, can simply be to repeat an entry that is already there. For example, if the first entry in the Position text box is `-1"`, you can type `-1` in the text box, then choose OK to close the dialog box. The appropriate procedure, therefore, would be to choose Layout Line Tab Set, reenter the setting currently showing in the Position text box, and then choose OK.

Note that with any version of WordPerfect, you can extend the underlying concept here to other settings (such as left and right margins) that you want to change for a short section of text. You can also take advantage of the same capability when first entering text. When you reach the beginning of the section you want special settings for, simply add a few extra hard returns, enter the code for returning to the settings you started with, then move the cursor back up, enter the tab settings for the start of the section, and enter the text for that section. When you're finished, press Alt-F3 to see the Reveal Codes screen, and delete any extra hard carriage returns between the end of the differing section and the code that resets the tabs.

Finally, if you enter the beginning code first, or you accidentally delete the code at the end, you can enter the tab settings before the section (so it will automatically take on the original settings), then highlight the code on the Reveal Codes screen, delete it, and insert it at the end of the section by choosing F1 (which is Restore in WordPerfect), or giving the Edit Undelete command in WordPerfect for Windows.

Foreign-Language Characters

I work for a Brazilian bank and regularly need to type Portuguese with my word processor, Microsoft Word 5.0. For most characters and accents not found in the English language, I can hold down the Alt key and type the ASCII code on the numeric keypad in order to get the characters I need; for example, C cedilla (ç, ASCII 135, or Ç, ASCII 128) and E acute (é, ASCII 130, or É, ASCII 144). But among the most common characters in Portuguese are *A*, *a*, *O*, and *o* with a tilde (~) over the top. I can print them with the Lotus 1-2-3 or Symphony Compose commands, but I have not found a way to do this in Word. (I've tried using the keyboard driver, but that changed too many key arrangements, making it confusing to use.) Is there any way to obtain these letters without changing my keyboard layout?

Charles N. Ryan
Scarsdale, New York

▶**PC MAGAZINE** There are several approaches for printing these (and other) characters. The preferred choice will depend largely on your printer.

The *high-order* (or *extended*) ASCII codes (ASCII 128 to 255) will yield different characters depending on which extended character set you're using. The high-order characters you see on-screen when using Word are the IBM high-order characters, often called the PC-8 character set (because it makes use of eight bits per character rather than the seven bits for standard ASCII characters). As it happens, this particular character set does not include the *A*, *a*, *O*, or *o* with a tilde.

However, Word does not send *characters* as such to the printer. It sends character *codes*. So if the printer uses a different character than the screen uses for any given code, the printout will not match

CHARS.BAS
Complete Listing

```
10 OPEN "HICHAR.ASC" FOR OUTPUT AS 1
20 FOR N=128 TO 255
30 PRINT #1, N " " CHR$(N)
40 NEXT N
50 CLOSE 1
```

Figure 1: **This BASIC program will produce a pure text file with all the character codes from 128 through 255, with each code labeled with its value.**

the screen. Some printers even provide alternative character sets so that you can print different characters with the same character code simply by changing the character set at the printer.

Word users should also be aware that Word's .PRD files, or printer description files, can automatically change character sets at the printer or even send different codes to the printer than the code you see represented on-screen.

If you install Word for the HP LaserJet II, for example, using the HPLASER.PRD file you'll find both Courier and CourierPC listed as font choices. The only difference between these two fonts is their character sets for the high-order characters. Note that you'll see the same high-order characters on-screen regardless of which font you're using. But you'll get different high-order characters when you print the document. The CourierPC font choice uses the IBM-PC high-order characters. The Courier choice uses the HP LaserJet's Roman-8 character set, which includes the *A*, *a*, *O*, and *o* with tildes.

Word's .PRD files can also include one or more character-translation tables. A translation table can assign any character or string of characters in the printer to any ASCII code you enter in a file. For example, if your printer doesn't offer an *A* with a tilde over it, you can create the equivalent by defining one of the codes as an *A* followed by a backspace (designated as ^H), followed by a tilde. If you wanted to, you could assign each font to a different translation table.

The upshot of all of this is that your printer may already offer the characters you need. What's more, the characters may already be available through Word as shipped; but even if they aren't, you should still be able to print them by modifying the .PRD file.

To keep this discussion reasonably brief, I won't go into the details of modifying .PRD files in this column. You can find the instructions in Word's Printer Information manuals for 5.0 and 5.5 in the chapter "Using the MakePRD Program." (If I receive enough letters requesting the details, I'll cover them in a future installment of this column.)

In any case, if you need to print characters that aren't part of the standard ASCII character set, the first step is to find out whether the characters are available through the printer settings and .PRD files you already have. Essentially, you have to print each character available in each font, and then look for the characters you need.

128	Ç	143	Å	158	£	173	¡	188	Î	203	ù	218	Ö	233	Õ	248	°
129	ü	144	É	159	ƒ	174	«	189	§	204	ã	219	Ü	234	õ	249	·
130	é	145	æ	160	á	175	»	190	Ï	205	ë	220	Ê	235	Š	250	·
131	â	146	Æ	161	í	176		191	Ì	206	õ	221	Ï	236	š	251	¹
132	ä	147	ô	162	ó	177	Ÿ	192	Ô	207	ü	222	Ì	237	ø	252	³
133	à	148	ö	163	ú	178	ÿ	193	Ò	208	Å	223	Ô	238	Ÿ	253	²
134	å	149	ò	164	ñ	179	°	194	Û	209	Í	224	Á	239	þ	254	■
135	ç	150	û	165	Ñ	180	À	195	ã	210	Ø	225	Ì	240	Þ	255	
136	ê	151	ù	166	ª	181	Ã	196	-	211	Æ	226	Ã	241	±		
137	ë	152	ÿ	167	º	182	Ã	197	é	212	å	227	Ð	242	‗		
138	è	153	Ö	168	¿	183	È	198	ó	213	Í	228	d	243	µ		
139	ï	154	Ü	169	®	184	È	199	ú	214	ø	229	Í	244	¶		
140	î	155	¢	170	¬	185	Ë	200	à	215	æ	230	µ	245	¾		
141	ì	156	£	171	½	186	¤	201	è	216	Ä	231	Ó	246	-		
142	Ä	157	¥	172	¼	187	£	202	ò	217	ì	232	Ò	247	¯		

Figure 2: **This sample printout on an HP-compatible printer uses Word's HPLASER printer description file and the Courier font choice. The .PRD file uses a character-translation table to modify the standard Roman-8 character set output. The result mimics the IBM character set for codes between 128 and 175.**

Note that printing the same test file with Word's POSTSCRP.PRD file and a printer equipped with an Adobe PostScript cartridge also yielded the uppercase and lowercase *A*s and *O*s with tildes. But in that case, the characters were associated with different codes (179, 190, 199, and 245). And it's important to remember that because you need different codes for different printers, your document files will be printer-specific. If you're going to need to print the document files on more than one printer, you'll probably want to modify the .PRD files in order to maintain consistency among the printers.

Of course, if the characters you're looking for don't show up in any of the font choices in the .PRD file as shipped, again you'll have to modify the .PRD file. But be sure to explore *all* the font choices available for your printer. If any are defined as using a different character set, you'll get different results, and it's important to know which font choices produce which characters. □

You can create a test file easily enough in Word. Simply type each ASCII code number, a few spaces, and then the character code itself by holding the Alt key down while typing the code on the numeric keypad. Alternatively, you can use your favorite programming language to produce the file. Figure 1 shows a short BASIC program that will create an appropriate file for the high-order characters (HICHAR.ASC as shown). The program will enter one character code and its appropriate code number on each line.

Figure 2 shows a sample printout of the file after formatting it for multiple columns in Word. This particular sample was printed with Word set for an HP LaserJet II using the HPLASER printer description file, the default Courier font, and printing to an HP-compatible printer (a Canon LBP-8 Mark III, equipped with a LaserTwin LaserJet II emulation cartridge from Metro Software).

The uppercase and lowercase *A*s and *O*s with tildes (codes 182, 226, 233, and 234) are all available, as shown in Figure 2. If you get similar results with your printer, you can use these characters simply by entering the appropriate ASCII codes in your documents. The characters you see on-screen will not match the characters that print (182 appears as a graphics character in the IBM set, while 226, 233, and 234 are Greek letters). But they will still produce the results you need in the printout.

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CIRCLE 309 ON READER SERVICE CARD

CONNECTIVITY

Holding On-line Conferences: Conducting meetings over your LAN **File Management on a Server:** Control and estimate file space requirements.

BY FRANK J. DERFLER, JR.

Connecting Macs with PCs

In the May 12, 1992, issue, you described how to link Macintosh computers to NetWare, VINES, and LAN Manager ("Across the Great Divide: PC-to-Mac Connections"), but you didn't give any hints for integrating Macs with peer-to-peer networks like LANtastic. Is it possible to connect a Mac network to this type of system also?

David Coleman
Atlanta, Georgia

▶PC MAGAZINE Yes it is. A product called MacLAN Connect F/P, from Miramar Systems (805-966-2432), turns a PC into a gateway between the LANtastic and Macintosh network environments.

MacLAN Connect carries a rather high retail price of $995, but you need only one copy to link the networks. The gateway PC becomes an AppleShare file server operating over the AppleTalk Filing Protocol (AFP) standard. Physical and logical drives on the LANtastic side are available as AppleShare volumes. MacLAN supports a mapping scheme between the two different file systems, but it's almost always better to stick to the DOS naming system. And your Macintosh computers will be able to use PostScript-compatible printers on the LANtastic side through the Apple Chooser interface, just like an AppleShare printer.

Missing Your Queues

The October 15, 1991, Connectivity column presented a tip from reader Steve Wike concerning remote printing in NetWare 3.1. The setup seems like it should work, but the print server's timing creates a pitfall. When rebooted, a workstation running RPRINTER loses its connection to the queue it serviced. PSERVER, when polling the print queues, however, continues to recognize the connection for a longer time than the node takes to come up. RPRINTER attempts to reload but PSERVER has yet to release the queue and will refuse to assign the workstation to it.

The solution listed below uses the RPRINTER status command to check for a link between the local printer and the appropriate queue and initiates calls for continual execution of RPRINTER until a connection is established.

If we name the print server PRINTSERVER and make the printer number 1, then AUTOEXEC.BAT would contain the following:

```
IPX.COM
NETx.COM
RPRINTER.EXE PRINTSERVER 1
CHECKRMT.BAT
```

(The *x* in NET*x*.COM should be replaced by the number corresponding to the major version of DOS on the workstation.) The batch file CHECKRMT.BAT (patterned after an idea submitted by John Gatto in the the February 26, 1991, User-to-User column) is shown below:

```
ECHO N | RPRINTER -S >
 ISPRNTER.TXT
FIND /C "No remote printer is
 loaded" ISPRNTER.TXT > RMTPRNT.BAT
```

If `RPRINTER -S` finds no print device, the text "No remote printer is loaded" will be stored in ISPRNTER.TXT. FIND /C run on this file will show ten dashes followed by a space, the filename, a colon, another space, and a count of the number of times this string occurred. This result, either

```
---------- ISPRNTER.TXT: 0
```

if a link was established or

```
----------ISPRNTER.TXT: 1
```

if there was no connection is redirected to RMTPRNT.BAT.

RMTPRNT.BAT runs next, passing ISPRNTER.TXT: and the count following it as the first and second parameters to another batch file called --------.BAT. (Note there are eight dashes, not ten here; DOS ignores the extra two "filename" characters.) --------.BAT is shown below:

```
IF %2==1 GOTO RETRY
ERASE RMTPRNT.BAT
ERASE ISPRNTER.TXT
GOTO :END
:RETRY
RPRINTER PRINTSERVER 1
CHECKRMT
:END
```

If the count is 1 (that is, "No remote printer is loaded"), RPRINTER executes again, as does CHECKRMT, starting the cycle over; otherwise, the print queue assignment was successful.

Many hardware and network factors determine the number of times RPRINTER executes. We experience from four to eight retries upon rebooting a workstation.

Wayne Woogen
Monmouth Junction, New Jersey

▶PC MAGAZINE Someone resetting a PC that was acting as a remote print server

can certainly upset printer operations. We found that it takes our PC running PSERVER several minutes to discover the broken connection.

This batch file scheme isn't elegant and it generates a high level of traffic on the network, but it's an easily implemented and effective scheme to get the print server back into operation.

Holding On-line Conferences

I've always enjoyed reading the Connectivity column; you have provided a lot of helpful information. Now I hope you can help me once again.

I'd like to know if there is an application or utility that will let me set up a multiuser chat on our peer-to-peer network. Our company would like to be able to hold on-line meetings.

Jesus J. Caro
Jersey City, New Jersey

▶**PC MAGAZINE** I've noted recently that the business press seems to have discovered the value of on-line meetings. Many group-dynamics gurus are saying that people are more candid and meetings more efficient when people communicate on-line. They favor on-line discussions for certain brainstorming and productivity tasks, even when individuals and facilities are available for face-to-face meetings.

Since 1989, Mustang Software (805-395-0223) has sold an excellent product called Brainstorm that allows people working at client PCs anywhere on a network to join an on-line discussion group. The company markets many versions of the product, including one that lets users coming in over LAN-to-LAN links participate, with prices that range from $349 to $999.

Give it a try. Ideas flow freely in networked conferences.

File Management on a Server

The hard disk on our NetWare server continues to fill up as people learn to trust and use the network. We've tried giving people only limited amounts of file space, and we've tried erasing files by specific date, but both solutions are very unpopular with our users. Buying more hard disks, however, is unpopular with management. Is there a software package that can help us control storage space for files and perhaps predict our future needs?

Paul Sorenson
New York, New York

▶**PC MAGAZINE** FileWizard, from Knozall Systems (800-333-8698), is a disk management tool for NetWare servers that helps you move unused files from your server to indexed PKZIP files. The program also contains a graphical analysis tool that lets you view the current status of a server's drive.

The graphs include a bar chart that shows the age of the files on a disk volume, based on the date those files were last accessed or updated. The Forecast Analysis graph provides a breakdown of the disk usage pattern over the last year. This graph indicates any change in the average amount of space used each month, as well as the approximate date you'll run out of disk space. Knozall Systems sells a FileWizard NLM, and a version called FileWizard Lite for NetWare Lite.

The Airport Phone Modem Mystery

I travel a great deal and I usually take a laptop along since I frequently need to transfer data back to my office. In airports across the country I've seen (and tried) a type of AT&T credit card–operated telephone that advertises a laptop modem port. I've followed the instructions for connecting my modem to the phone, but I've never been able to get it to work. Do you have any suggestions?

Jim Dieter
Houston, Texas

▶**PC MAGAZINE** I've been frustrated by those same AT&T credit card–operated telephones in Atlanta, Memphis, and Salt Lake City. The division of AT&T that produces these devices deserves credit for recognizing that many people would like to have a modem connection available for long-distance calls, but the designers need some lessons in PC usability.

These phones have a list of instructions for making modem connections. You connect your own RJ-11 cord between the modem and the jack in the phone, then lift the handset and dial the number. There's no way to fool the phone and let your modem dial the number—even though many calls are to 800 numbers. When you hear the answering modem, you hang up the handset and use your laptop's communications software to tell the modem to start sending the originate tones.

That's how it's *supposed* to work.

I confidently connected my Zeos laptop, put my software into terminal mode so I could address the modem directly, dialed the number for MCI Mail, heard the answer, hung up the handset, and issued what I thought was the right command to the modem. I used ATH1 to take the modem off-hook, but all that did was let me hear the answer tone through the speaker; it didn't force the modem to generate the originate tone. To make a long story short, I tried every command I knew with no success.

PC Magazine executive editor Bill Howard, author of the *PC Magazine Guide to Laptop Computing*, had the right answer: Send the command ATX0D to your modem. The five modem manuals I consulted said that the ATX family of commands is supposed to control result codes and none of them listed anything beyond ATX0, but the ATX0D command worked!

Placing your communications software into terminal mode and sending ATX0D to the modem forces it to go off-hook and issue the originate tones. You should insert a terminal mode entry with ATX0D in your software dialing directory so you can take advantage of AT&T's widely available—but difficult to use—credit card–operated telephones that feature a modem port. □

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tip we print. Please submit your letter on-disk along with a printout. Then mail your contribution to Connectivity, *PC Magazine,* One Park Ave., New York, NY 10016. You may also contact Frank J. Derfler, Jr., via MCI Mail (MCI ID: 240-2931) or the LAN Labs fax machine (904-267-1578). We regret that we are unable to acknowledge submissions or answer letters individually.

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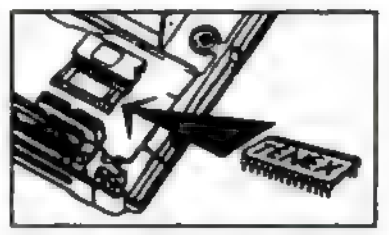

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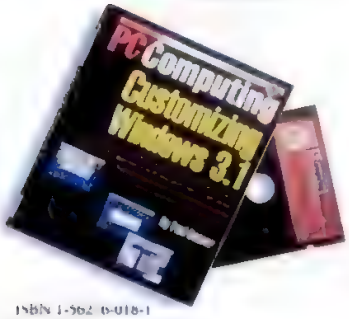

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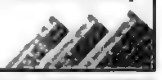

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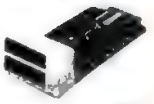

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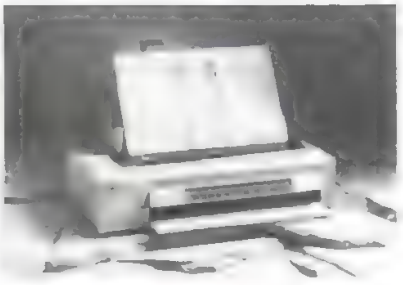

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PC MAGNET

Acronyms, Emoticons, and Lurkers: What are those strange capitalized abbreviations you see on-line?

BY ORVILLE FUDPUCKER

BTW, what are these often puzzling groups of characters scattered throughout the messages you read on PC MagNet, ZiffNet, CompuServe, and BBSs? Trying to figure out what the author is saying can sometimes be a real PITA; OTOH the meaning can often be gleaned from the context.

The technical term for these gems of brevity is *acronym*, which is defined as a word formed from the initial letters of each of the successive parts or major parts of a compound term. Some acronyms have passed into the language and are now ordinary nouns. *Radar* started life as an acronym for the *ra*dio *d*etection *a*nd *r*anging devices that were developed around 1943. Science fiction writer Robert A. Heinlein made TANSTAAFL (*t*here *a*in't *n*o *s*uch *t*hing *a*s *a* *f*ree *l*unch) famous in one of his novels.

The abbreviations are not designed to confuse you. Some came into being in the days of Morse code, where brevity was a virtue. Others came from busy people with hunt-and-peck typing skills, some from the jargon of a particular field, and some simply as savers of bytes and time.

Another acronym-turned-noun is *snafu*, which was coined by Morse code operators and means (in polite company, at least) "*s*ituation *n*ormal—*a*ll *f*ouled *u*p." They are also credited with FUBAR: *f*ouled *u*p *b*eyond *a*ll *r*ecognition. FUBAR is sometimes written as it is pronounced—FOOBAR—and used as a sample program name, such as FOOBAR.TXT, FOOBAR.MSG, FOOBAR.EXE, or just FOO.BAR.

Some acronyms are even good to eat. The TSJD is a *T*exas-*s*ize *j*elly *d*onut from a bakery in beautiful downtown Plano, Texas. It has become the official dessert of many sysop (*sy*stem *op*erator) gatherings around the country.

Acronyms and abbreviations are not bad in themselves but can block communication if overused. Some common ones around ZiffNet are BTW (*b*y *t*he *w*ay), BBS (*b*ulletin *b*oard *s*ystem), PITA (*p*ain *i*n *t*he "*a*natomy"), ROF,L (*r*olling *o*n *f*loor, *l*aughing), OTOH (*o*n *t*he *o*ther *h*and), IANAL (*I* *a*m *n*ot *a* *l*awyer), IAC (*i*n *a*ny *c*ase), OIC (*o*h, *I* *c*see), FWIW (*f*or *w*hat *i*t's *w*orth), FYI (*f*or *y*our *i*nformation), IMO (*i*n *m*y *o*pinion), and IMHO (*i*n *m*y *h*umble *o*pinion). Rarely is the author humble in this case.

People often have problems with a program or equipment because they don't RTFM (*r*ead *t*he "*f*riendly" *m*anual). FWIW, the acronym TSR (*t*erminate and *s*tay *r*esident programs), DOS in the context of machines (there's another one!), and the description WYSIWYG (*w*hat *y*ou *s*ee *i*s *w*hat *y*ou *g*et) for desktop publishing (sometimes referred to as DTP) are just about standing on their own now.

Message writers can use <g> or <grin> to mark a joke or to take the sting out of a sarcastic comment on-line.

The CompuServe forums used to be called Special Interest Groups, and some still have SIG in their names, such as AVSIG, PRSIG, M100SIG, TRAVSIG, LAWSIG, and MEDSIG. In the early days of CompuServe, the programmer/project number was a PPN. This evolved into today's User ID, which many still refer to as a PPN.

One of the problems with using this faceless electronic media for the conversationally written word is the lack of voice inflection or body language that is normal to conventional conversation. Message writers often use symbols to denote their feelings in a message. Sometimes they use a word or a letter inside of brackets; for example, a <g> or <grin> to mark a joke or to take the sting out of a sarcastic comment. Some writers seem to be enamored with angle brackets and their messages are full of <smile>s, <shrug>s, <smirk>s, and <sigh>s.

Icons are pictorial representations, such as a trash can icon on a GUI screen that represents file deletion. (What's a GUI? That's a *g*raphical *u*ser *i*nterface, used by computers and by such programs as Windows, OS/2, and GeoWorks.) An emoticon is an *emo*tional *icon*, or a pictorial representation of the emotions of the moment. These are most commonly created on one line using the symbols on the keyboard. Humor is often denoted with the smiley face :-) which is more obvious if you tilt your head to the left. Variations on this are the sad face that occurs after hard disk failure :-(or the no-smile face :-| which can denote puzzlement—or tongue-in-cheek :-J or the raised eyebrow ;-).

Many forum members never enter into the conversations or leave any messages. They are referred to as *lurkers*. This is not a derogatory term at all, but simply a reflection of their silent activity. If you see an emoticon or an acronym that you don't understand, just put up a message and ask what it means. You will make a multitude of lurkers happy!

For more information and a list of many emoticons and acronyms, go to the UTILFORUM Library 1 (General Information) and download ACREMO.TXT. You may find this a genuinely useful file for on-line communications. TTFN (*t*a-*t*a *f*or *n*ow). □

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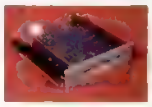

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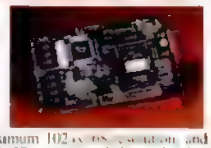

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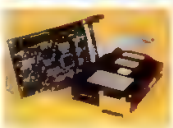

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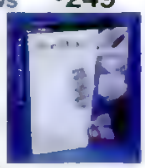

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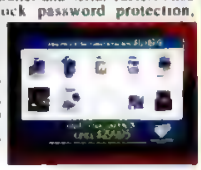

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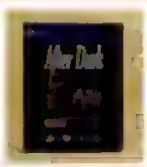

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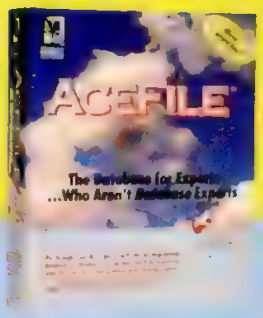

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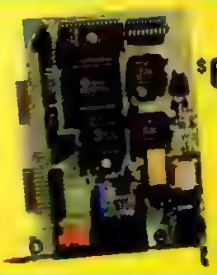

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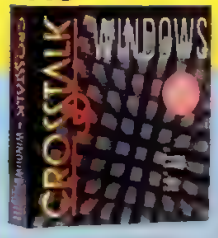

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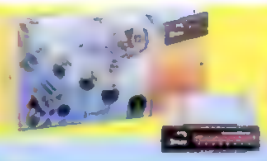

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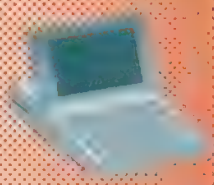

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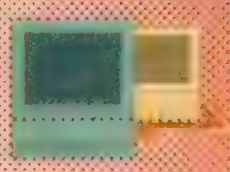

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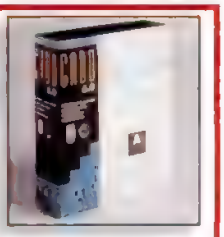

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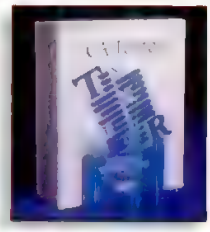

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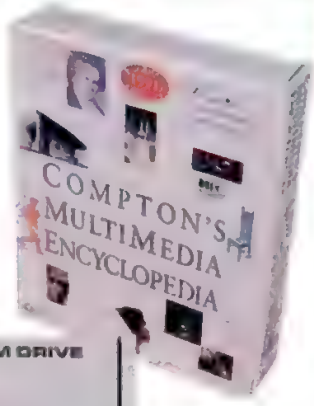

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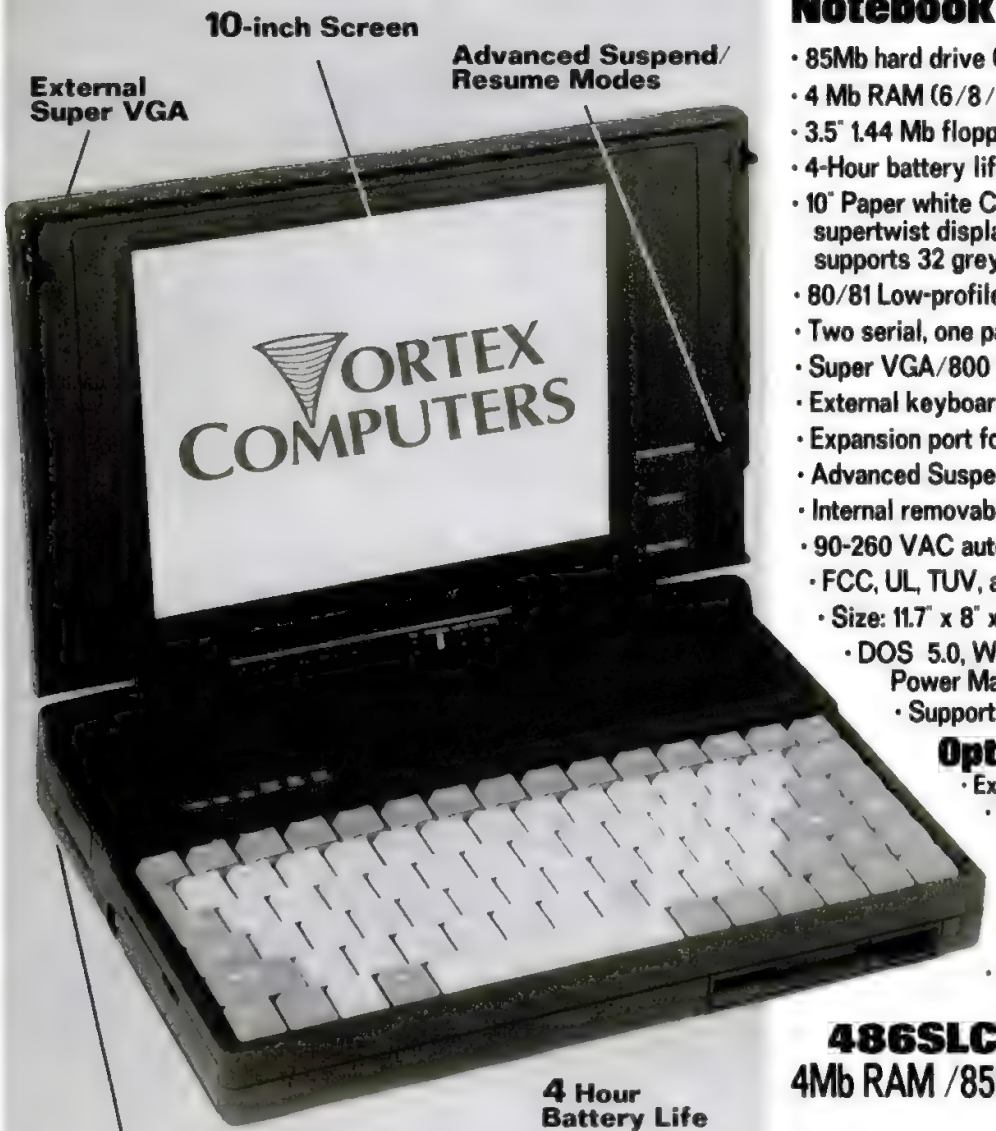

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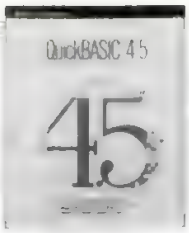

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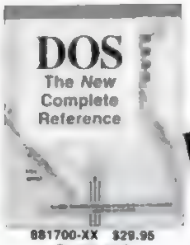

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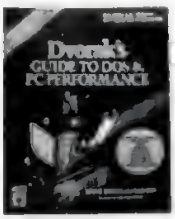

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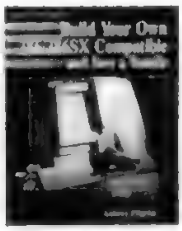

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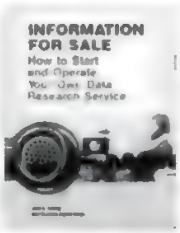

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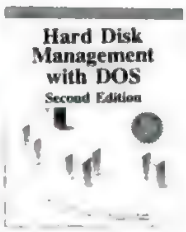

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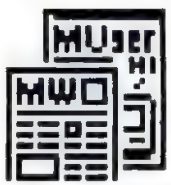

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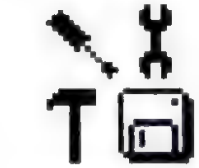

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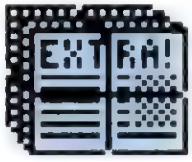

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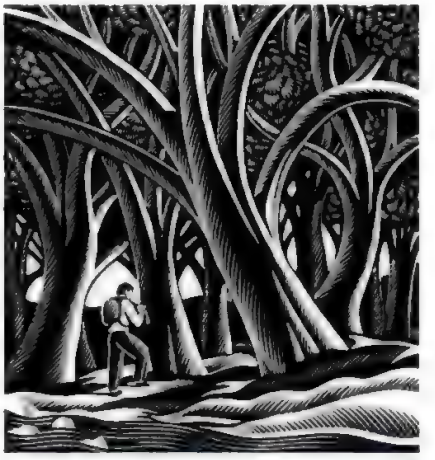

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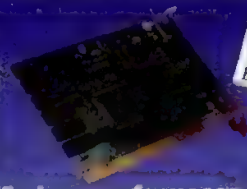

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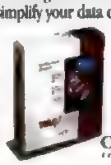

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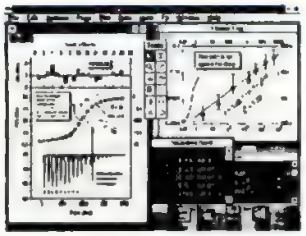

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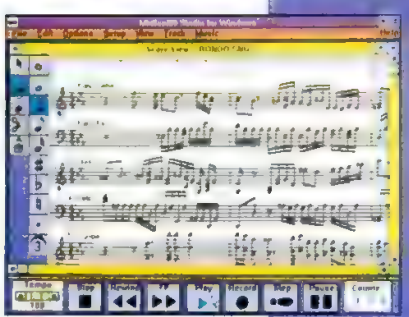

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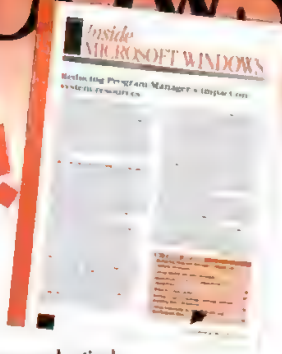

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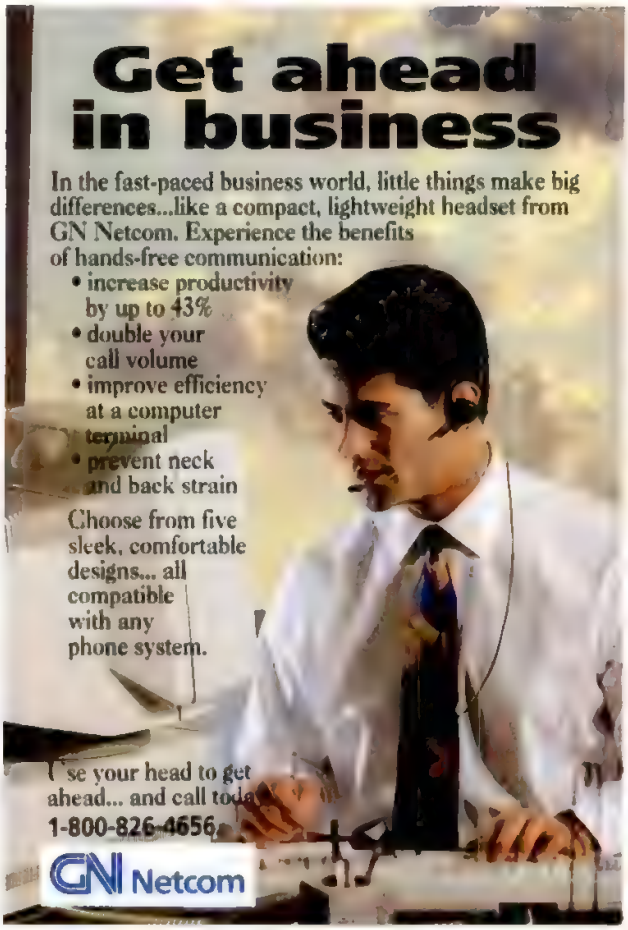

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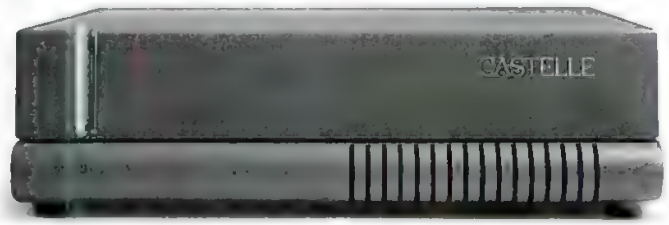

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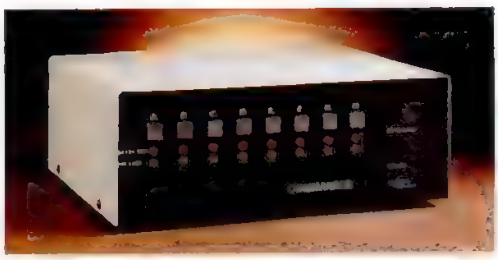

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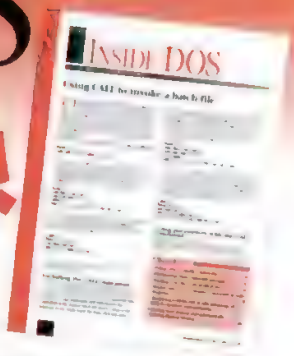

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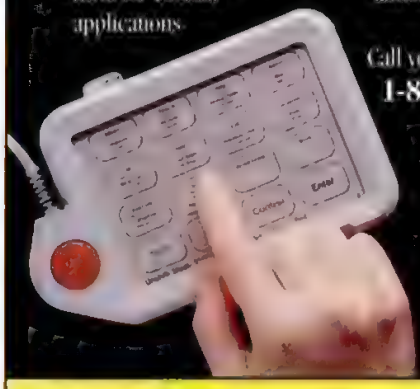

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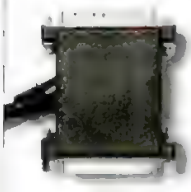

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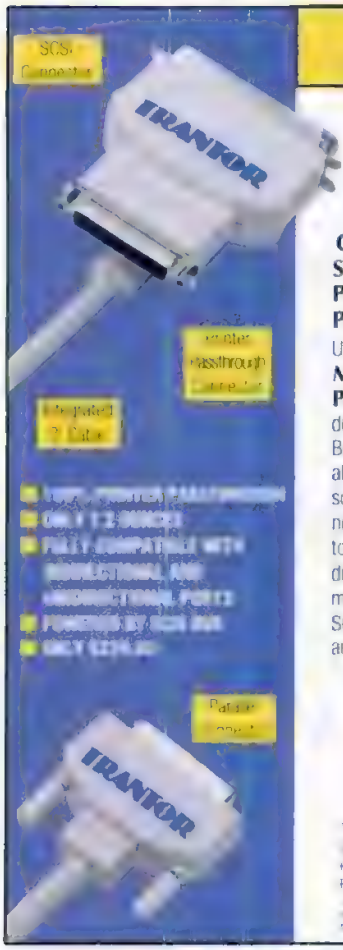

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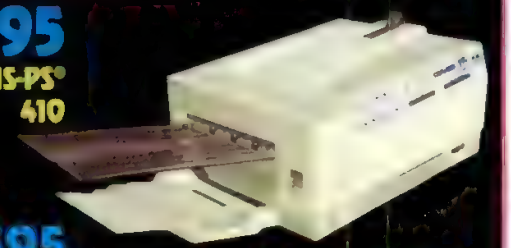

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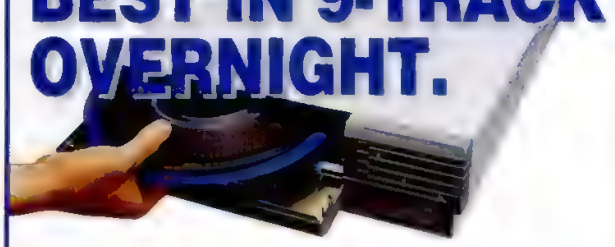

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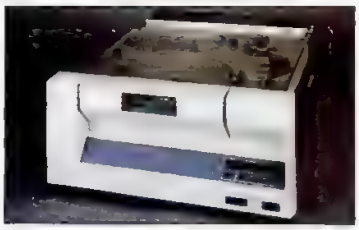

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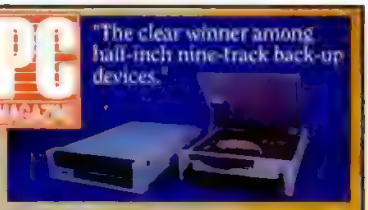

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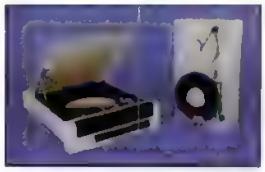

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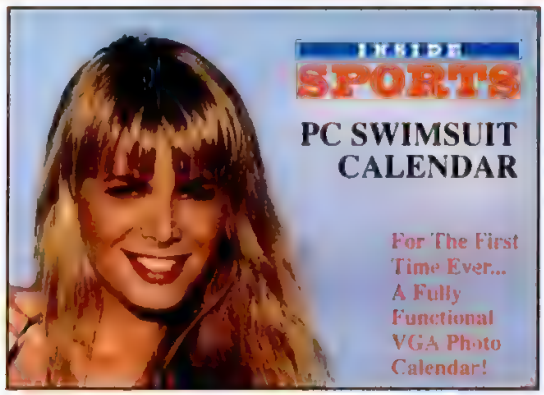

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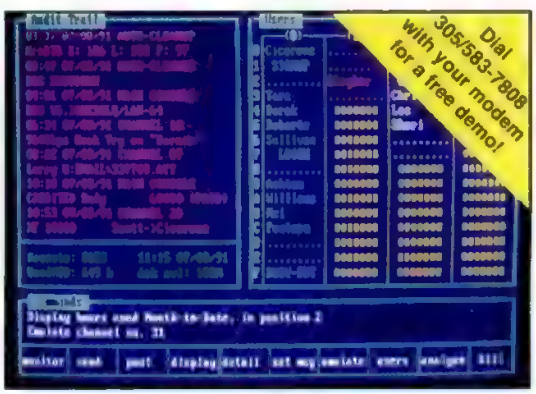

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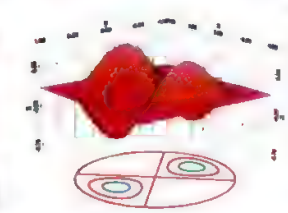

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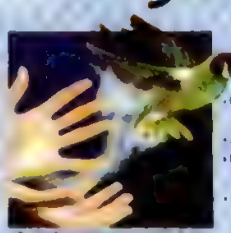

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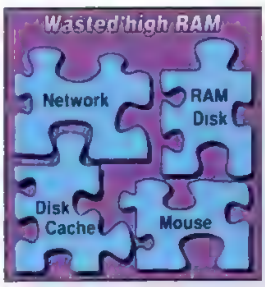

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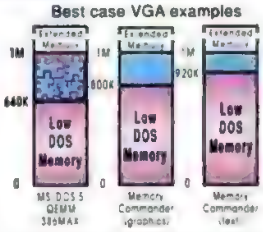

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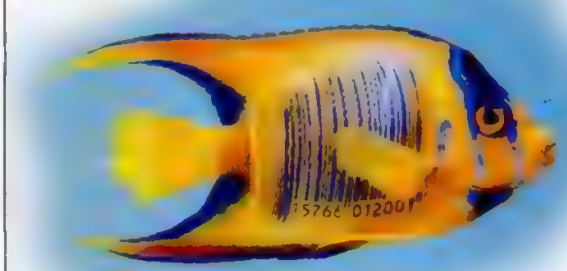

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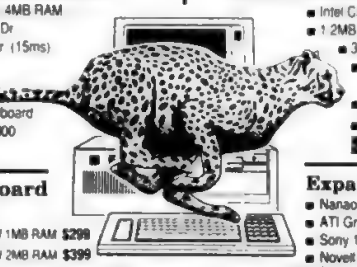

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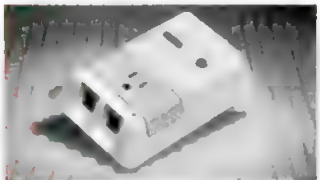

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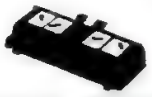

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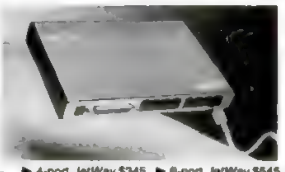

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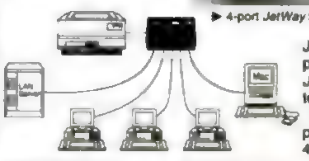

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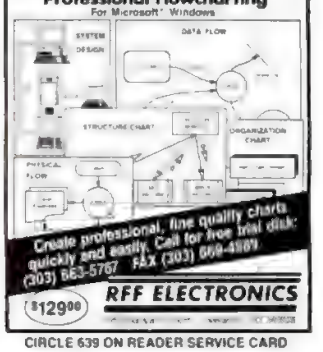

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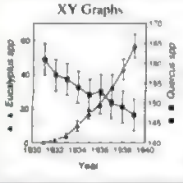

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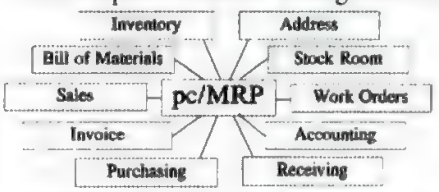

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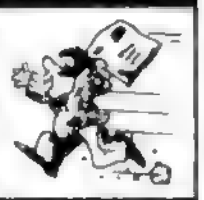

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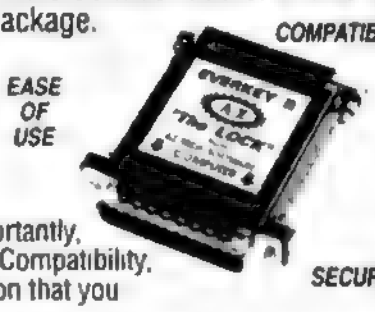

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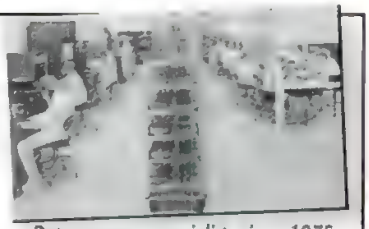

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												001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035
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Coming Up

50-MHz 486 DX2 PCs

Word is out on the PC street that there's a 50-MHz 486 machine within your reach. The speed-doubling technology of Intel's new 486DX2 microprocessor promises to give you the high performance of the 50-MHz 486DX at 25-MHz prices. But does it deliver? PC Magazine Labs tests 61 50-MHz 486DX2–based systems, including offerings from ALR, Amkly, AST, Austin, Compaq, Dell, Gateway 2000, IBM, Micro Express, NCR, NEC, Northgate, Tandy, and Zeos.

Monitoring Software

When something goes wrong with your network server, it can take hours to figure out what went wrong, when the failure occurred, and why. *PC Magazine*'s networking team looks at server monitoring software that helps predict breakdowns by allowing network administrators to set thresholds for CPU and disk utilization, for dirty cache buffers, and for other vital server statistics. We will examine the packages' analytical and reporting capabilities, as well as their interfaces and alarm systems.

SQL Servers

SQL (structured query language) was once available only to users of hulking mainframes. But now that the power of a mainframe can fit on your desktop, you too can use this simple yet powerful engine for your most complex databases. A SQL database can give users strikingly quick access to huge data files over a PC-based network. Our applications development team, in the first article of a two-part series on SQL, describes when SQL is a good choice for your business and looks at the available engines (or "back ends") for SQL servers.

Utilities

Wouldn't it be nice if you could run a program using your LAN server's CPU instead of your own? Next issue's utility, REDD.SYS, lets you do this and more. A remote executable device driver, REDD lets you execute programs on DOS-based LANs just as if you had entered their commands from the server keyboard. Now you can execute applications that access large amounts of data on the machine where the data is located, reducing overall demand on the LAN; you can run one application on your machine while you execute another on the server; and you can run your programs on the fastest machine available.

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CIRCLE 317 ON READER SERVICE CARD

After Hours

HOME CAD: Design Your Own Home, EasyCAD2, Expert Home Design, Floorplan Plus, The Home Series
MUSIC: Miracle Piano Teaching System

HOME CAD

Build Your Dream Home: Five CAD Packages Make Architecture Easy

BY DON TRIVETTE

Whether you're designing your dream home or remodeling your kitchen, a growing collection of software can make your job easier and perhaps even less costly. You can convey your ideas to your builder or architect and experiment with them on paper, rather than in mortar.

We have evaluated five entry-level computer-aided design (CAD) programs—from Abracadata, Autodesk Retail Products, Computer-Easy, Evolution Computing, and Expert Software—that help you get the job done.

Although many of these programs have more in common with ordinary drawing programs than with the professional CAD packages used by architects, building contractors, and engineers, they do have special features to make drawing floor plans, elevations (side views), furniture, and landscaping easy. Several companies also publish separate programs for interiors, bathrooms, kitchens, or landscapes.

Quality, value, and ease of use vary from one package to the next. Abracadata's $99.95 Design Your Own Home and Autodesk's $59.95 Home series, for example, are more frustrating than other more CAD-like packages, and they are shamefully overpriced for what they offer. Computer-Easy's $79.95 Floorplan Plus incorporates most of the symbols you will need, but the software lacks two important features: layers and fills. Expert Software's Expert Home Design also lacks some crucial features, but this $14.95 package is the one to buy if your needs are modest and your wallet slim.

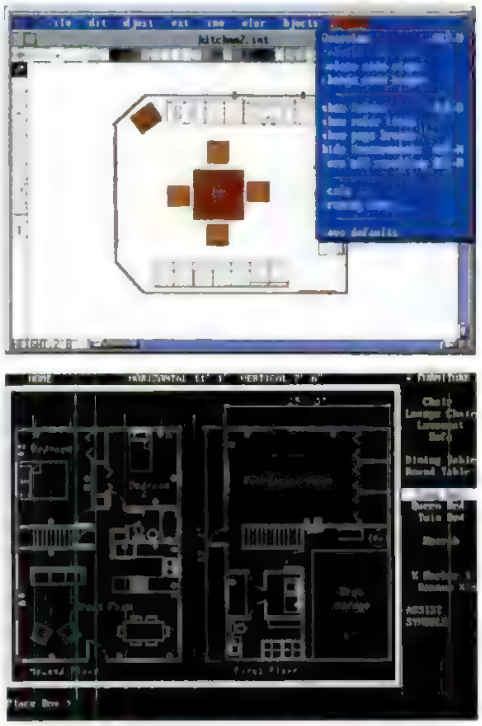
Evolution Computing's EasyCAD2, which comes with Microsoft Press's book, *Learn CAD Now*, is the most complete package in the group. At $39.95, it is a true software bargain. EasyCAD2 may be a bit more difficult to learn, but the reward makes the effort worthwhile.

DESIGN YOUR OWN HOME

Abracadata's three Design Your Own Home programs—DYOH: Architecture, DYOH: Landscape, and DYOH: Interiors—are essentially identical except for the predrawn symbols and fixtures. DYOH: Architecture helps you develop realistic floor plans and includes predrawn elements such as doors, windows, stairs, and furniture. DYOH: Interiors lets you arrange the furniture, and DYOH: Landscape helps you plan your yard. Your best bet: Stick to the original Architecture program and draw your own details.

The DYOH: Architecture module turns each element into an object, so each is easy to move, rotate, copy, and delete. To move a wall or a window, for instance, you select it and drag it to a new location; to erase a wall, you select it and press the delete key.

One advantage of an object-oriented drawing package is the ease with which you can store predrawn elements in a symbol library. Architecture's library includes doors, windows, stairs, electrical symbols, bathroom fixtures, and furniture. But each group contains too few items. Furniture, for example, includes a stove and a kitchen sink, but no refrigerator; there's an armchair and sofa, but no bed. How can you get the feeling for a bedroom's size without placing a bed in it? You'd have to buy DYOH: Interiors to get those extra symbols. You can draw your own furniture, but you can't save your piano, dresser, or refrigerator in the program's symbol library. Instead, you must save each element as a separate drawing and then use a cut-and-paste command to put that item in your current plan.



Autodesk's Home (bottom) has a good selection of symbols, including beds, tables, and chairs. Many such elements are also in Abracadata's DYOH:Interiors (top).

DYOH: Architecture offers a wide range of scales. In this package, 1 inch can equal any size from 1 to 1,000 feet. Builders and architects most commonly use a scale of ¼ or ⅛ inch equals 1 foot (1 inch equals 4 or 8 feet); a wide range can be convenient if not essential.

Unfortunately, you have to change the scale to magnify a section of your drawing; there's no separate zoom feature. It's also difficult to find the distance between two points, and there is no function for calculating area.

DYOH: Architecture also lacks a layering function, which would enable you to view floors on top of each other. Nor can you draw in color; elements and text are black on a white screen. You can use different fills (such as solid lines, bricks, or any of several dozen different patterns) to help differ-

entiate windows, walls, and floors. Color, however, tends to be useful to show features like heating, plumbing, and electrical systems.

Several canned floor plans come with the package, but they hardly represent anyone's idea of a dream house. They may, however, give you an idea of what you can do with this software.

If you purchase this package, look for Version 3.5. Abracadata has repaired the bugs found in Version 3.02.

Design Your Own Home: Architecture, *$99.95.*
Requires: *640K RAM, DOS 2.1 or later; mouse recommended. Abracadata, P.O. Box 2440, Eugene, OR 97402; 503-342-3030, 800-451-4871; fax, 503-683-1925.*
Circle 481 on reader service card

EXPERT HOME DESIGN

At $14.95, Expert Home Design is your best CAD buy—though you may choke when you see your tech-support phone bills. This package has a familiar user interface with pull-down menus at the top and a status line at the bottom of the screen. The black-on-white graphics are notably clean and crisp, and the drawing tools are well organized.

Of the five packages in this review, only Expert uses bitmapped graphics rather than vector graphics to draw floor plans. This technology makes possible a very handy eraser tool, which can be used to whisk away mistakes and nibble at walls. Other tools let you draw walls and windows and measure distances and areas. There's an undo tool, but it never would undo what I needed undone.

Expert Home Design has only two scales, labeled Large and Small. Neither represents the standard construction scale of ¼ inch or ⅛ inch to a foot. The software's scales restrict drawing sizes to either 35 by 75 feet or 70 by 150 feet. You cannot switch from one to the other once you've begun a drawing. The scale of hard-copy output varies with the printer installed. It is not user-controllable.

To the package's credit, the symbol library is unusually complete and detailed; it includes a sauna, a pool table, and a grand piano. No boxy drawings, these: You can recognize the piano's keyboard and the pool table's pockets. The only flaw is that all the furniture is sized for small-scale drawings. You can create and save custom symbol libraries, so you can draw your own large-scale furniture.

Although Expert lacks many of the features you would want in a more CAD-like package—zoom and pan, colors, layers, fills, and a definable scale—it's difficult to fault a $14.95 program that does what it does well. This package has its price, though. Tech support, available only through a 900 number, costs $5 for the first minute and 40 cents for each additional minute. So much for the bargain.

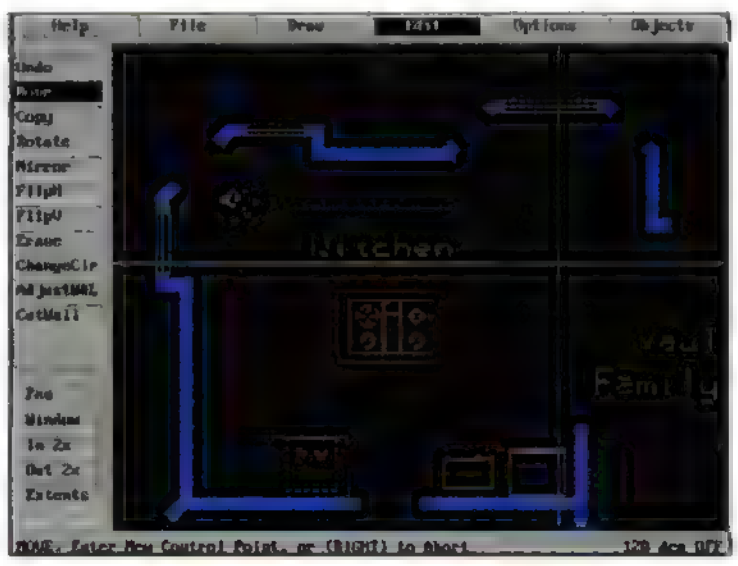
Expert Home Design, *$14.95.*
Requires: *640K RAM, DOS 2.11 or later; mouse recommended. Expert Software, P.O. Box 143376, Coral Gables, FL 33134; 800-759-2562; fax, 305-443-3255.*
Circle 482 on reader service card

FLOORPLAN PLUS

Floorplan Plus borrows many of its features from professional CAD software. Its ability to use expanded memory is handy for large drawings; support for a math coprocessor speeds up certain functions.

Floorplan has an excellent user interface. Commands are organized in a logical and intuitive manner. Across the top of the screen are functions such as File, Draw, Edit, and Objects; selecting them brings up commands on the left side of the screen. A status bar across the bottom shows scale (1 inch can equal 4 through 630 feet) and other layout parameters.

Floorplan lets you move easily around a drawing. Pan buttons scroll the screen up, down, left, and right; three zoom commands magnify any element quickly. All CAD packages should operate this smoothly.



Floorplan Plus has an excellent user interface that makes it easy to pan and zoom to any area in the drawing you want to go.

Floorplan lacks some features, such as layering and fill patterns, but you might not miss all of them. With the package, you can draw in 16 colors, use American or metric scales, and measure lengths, angles, and areas. Floorplan has a displayable grid and can snap lines to grid points. The Undo command undoes the last command.

In addition to a line drawing tool, a separate tool lets you draw a wide variety of walls. Brick exterior, drywall interior, and office partition are the defaults, but you can easily customize new types by thickness and color.

More than 100 symbols, such as furniture, appliances, doors, windows, and landscaping items, come with the software. You may create your own symbol libraries and fill them with your own drawings. A developer, for example, might create fire hydrants, transformer boxes, and street lamp symbols, while a decorator would store pianos, bookshelves, and 20 types of tables. User-defined symbol libraries are a must for the serious draftsman. Here, Floorplan Plus has the other packages beat.

Floorplan Plus, *$79.95.*
Requires: *640K RAM, DOS 3.0 or later; mouse recommended. ComputerEasy, 414 E. Southern Ave., Tempe, AZ 85282; 800-522-3279, 602-829-9614; fax, 602-829-9616.*
Circle 483 on reader service card

THE HOME SERIES

Autodesk Retail Products has four design programs to help nonprofessionals organize and draft their ideas. Home is the general-purpose design package used to draw floor plans. Kitchen, Bathroom, and Landscape differ from Home only in their libraries of symbols. The Kitchen and Bathroom packages, for example, include cabinets, stoves, sinks, and the appropriate appliances; Landscape has detail down to the size and shape of the sprinkler's spray.

Along the right-hand side of the screen, the Home interface has a list of commands such as Draw, Change, Text, and Assist to control the drafting. If something isn't clear, you can press the F1 key to pop

up a command-sensitive help screen. There are no scales to set or grids to turn on, since Home uses a fixed drawing scale measured in feet and inches. You may, however, set a conventional scale (¼ inch equals 1 foot, for example) when you print a drawing, or you may opt to let the software fill the page.

A measuring function lets you calculate length, angle, and area for any feature on the plans. For example, to find the area of a house, just drag the crosshair cursor around the parameter of the floor plan. This feature can save time when you are trying to meet a minimum area requirement or estimate cost based on square footage.

You can also zoom in on and out of any part of the drawing by positioning a window over the section to be magnified. If you are moving furniture around a bedroom, for example, you can quickly magnify the bedroom to fill the entire screen.

Home's Oops and Redo commands are more powerful than those found in many professional CAD systems. By clicking Oops repeatedly, you can undo the last 25 changes you made to a drawing. Not only is this good for correcting drafting blunders, it is great for trying different ideas. Swap the location of the stove and the refrigerator, for example, and if you don't like it, click Oops until the appliances are back in their original places. Redo is the reverse of Oops.

This package does have its shortcomings. Like several of the packages in this review, Home lacks a layering function and the ability to draw in color. Nor does it have a fill feature. Home puts everything it creates on-screen as white lines on a black screen.

While users can't save their own symbols in a library, the standard symbols are fairly complete. Windows, for example, come in six sizes, and kitchen ranges in three. There's a wide variety of kitchen and bathroom sinks, too. You can also create a kitchen or bathroom using the Kitchen or Bathroom program and then import that file into Home.

Only three sample homes are included with the software, but users have access to many more. Home uses the same file format as Generic CADD, a popular professional CAD system for which hundreds of stock plans are available.

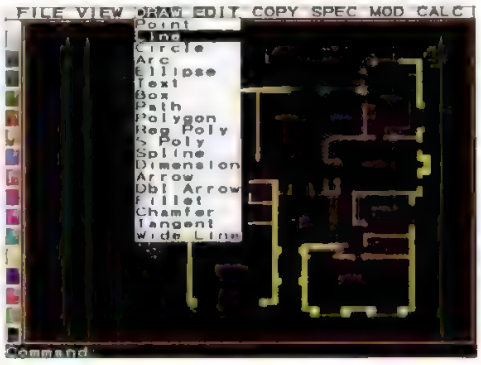
Home Series: Home, *$59.95.* Requires: *640K RAM, DOS 3.0 or later, mouse. Autodesk Retail Products, 11911 North Creek Pkwy. South, Bothell, WA 98011; 800-228-3601, 206-487-2233; fax, 206-485-0021.*

Circle 484 on reader service card

LEARN CAD NOW

Rarely is a CAD package self-explanatory; you need some lessons before you can create your dream home. To this end, Evolution Computing and Microsoft Press have teamed up to give you both the software and the knowledge you need. The book, *Learn CAD Now,* includes a working version of the software, EasyCAD2. Though you can buy the latter separately for $199, you won't be able to beat the bargain—or the tutelage—when you buy the book for just $39.95.

Learn CAD Now's version of EasyCAD2 is slightly disabled but highly useful. This version can't import or export different file formats and it doesn't have drivers for professional plotters or support for digitizers, but few other features are omitted. Above all, the price is right. The book even includes a coupon that lets users upgrade to the full version of EasyCAD2 for $80.



EasyCAD2 has a full range of drawing tools.

While other products come with manuals and quick-reference cards, *Learn CAD Now* is a 400-page reference book for EasyCAD2 software. It is also a beginners' CAD course and a good introduction to the art and science of drafting.

Across the top of EasyCAD2's screen are headings for pull-down menus such as File, View, Draw, and Edit; a color selection palette forms the left border. To draw a red line, for example, you would click on the red block, click on Draw, and then pick the Line command. Switching colors requires just one simple step.

Using blue for water, red for gas, orange for waste, and brown for air conditioning makes utility services stand out, but drawings may quickly become a colorful jumble. EasyCAD2 solves this problem by using layers.

Each layer acts like a piece of clear mylar; stacking several pieces together shows a composite drawing. For example, you might put a floor plan on the first layer; on a second, you might draw furniture. When you select both layers, the drawing shows you a floor plan with furniture, but by turning off one layer or the other, you can view either the plan or the furniture. You can use as many as 256 layers to show landscaping, utilities, upper floors, and text. Using multiple layers makes drafting easier and drawings much more legible.

Of these packages, only EasyCAD2 has a macro language, a powerful feature that lets the user write and store a sequence of commands. Although macros can be tricky to write, they are very easy to use. The offset macro (included in the program as an example) moves an object a specified parallel distance. The Move command performs the same operation but takes more steps.

Missing from early releases of the book's software was a collection of predrawn symbols, but the latest version of *Learn CAD Now* has a sample collection of 240 symbols and ten macros, courtesy of Atlantic Computing Enterprises in Vienna, Virginia.

EasyCAD2 also excels in the type and scope of its drawing tools. Besides common tools like line, arc, and circle, there are box, ellipse, spline, fillet, and chamfer tools. Indeed, there are six ways to draw a circle: center and point, center and radius, center and diameter, three points, two points, and tangent to two circles. If an object can be drafted, EasyCAD2 can do it.

Learn CAD Now, *$39.95.* Requires: *For EasyCAD2, 512K RAM, DOS 2.1 or later, mouse. Evolution Computing, 437 S. 48th St., #106, Tempe, AZ 85281; 800-874-4028, 602-967-8633; fax, 602-968-4325.*

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MUSIC

Miracle System Turns Your PC Into a Patient Piano Teacher

BY ROBERT KENDALL

Remember how much you hated taking piano lessons? The Miracle Piano Teaching System, The Software Toolworks' $479.95 MIDI keyboard and software, lets you learn easy pieces quickly, and there's no embarrassing recital to worry about.

Getting started is simple, and you don't need a MIDI interface. Just connect the keyboard to your PC's serial port. Miracle comes with built-in speakers, headphones, a sustain pedal, and amplifier jacks.

The software guides you through several hundred progressive lessons. A tone generator plays new material while an on-screen image shows the correct keys being depressed. At the top of the screen, the music appears in staff notation, while a moving pointer follows along. You repeat each section until you can play the whole composition.

A Practice Room lets you rehearse any of about 100 pieces, and in the Performance Hall, a synthesized ensemble accompanies you. Click on the Studio icon and a rudimentary sequencer lets you record your work.

The Miracle keyboard has MIDI In and MIDI Out ports. By adding a MIDI interface board, you can use any MIDI software. Passport Designs' low-end sequencer, Trax, also supports the keyboard's serial interface.

A patient instructor, the Miracle Piano Teaching System gives you all the keyboard basics.

With only 49 keys, the Miracle keyboard is 12 keys short of most MIDI units. The synthesizer's 128 instrument sounds and sound effects are mediocre, and the keyboard doesn't support effects such as pitch bend.

You won't learn proper hand position and posture with this system. It's a bit weak on music theory, and stops at the elementary level. But you may find it more patient than many live teachers. □

The Miracle Piano Teaching System, *$479.95.* Requires: *640K RAM, DOS 3.1 or later, serial port; mouse recommended. The Software Toolworks, 60 Leveroni Ct., Novato, CA 94949; 415-883-3000, 800-234-3088.*

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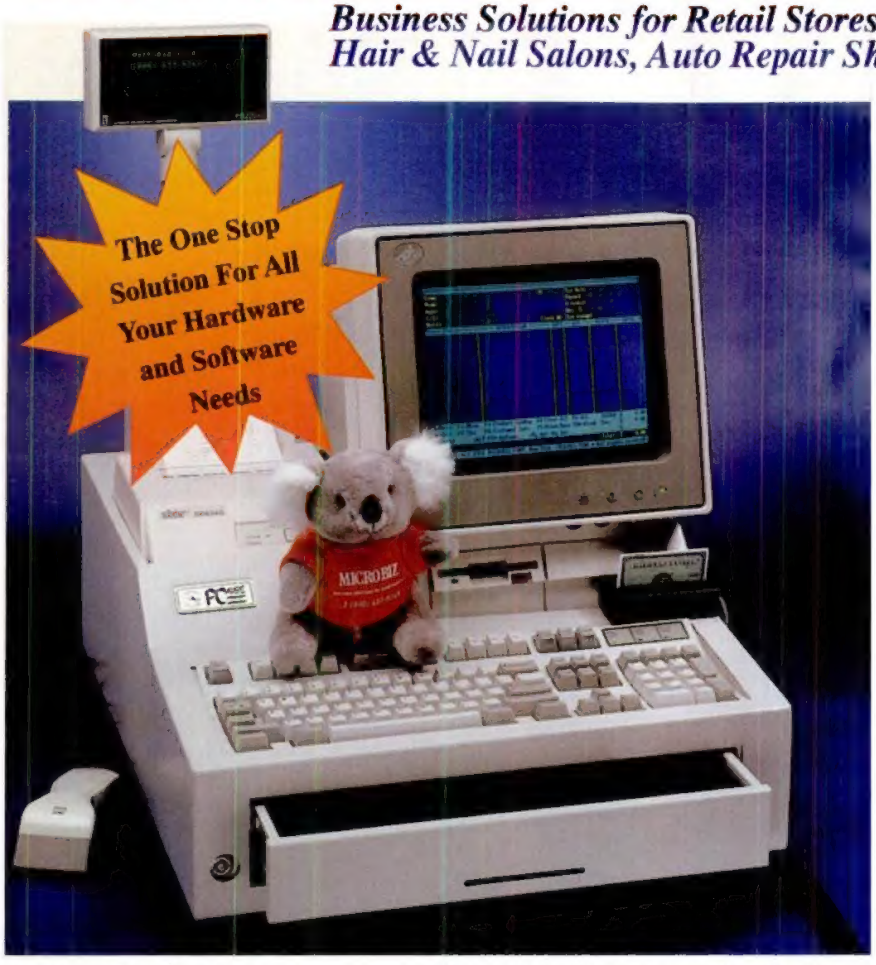

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Bill Howard

They Just Don't Get It Dept.: Microsoft BallPoint

Thumbs down to Microsoft for failing to provide a PS/2-connector version of its BallPoint pointing device. Users must remember to carry a clumsy DB-9-to-PS/2 adapter cable. Microsoft doubts there's demand for a separate product (funny—lots of new notebooks have the round PS/2 connectors) and thinks many users are too stupid to know if their laptops have them (not Microsoft's words exactly, but a pretty fair paraphrase), so they'd be confused when shopping. We say: Get with the program, Microsoft.

Users of laptops with PS/2-style mouse connectors must lug around this dorky adapter cable because Microsoft sells only one version of the BallPoint.

Amazing Facts

"Not only will the [Zenith laptop PC's] AC adapter run internationally but, the nicad battery is legal on most airlines. The 2MB RAM is battery backed up, making for non valatable [sic] RAM."
—AZTEC NETWORK SOLUTIONS AD, *COMPUTER SHOPPER*, APRIL 1992

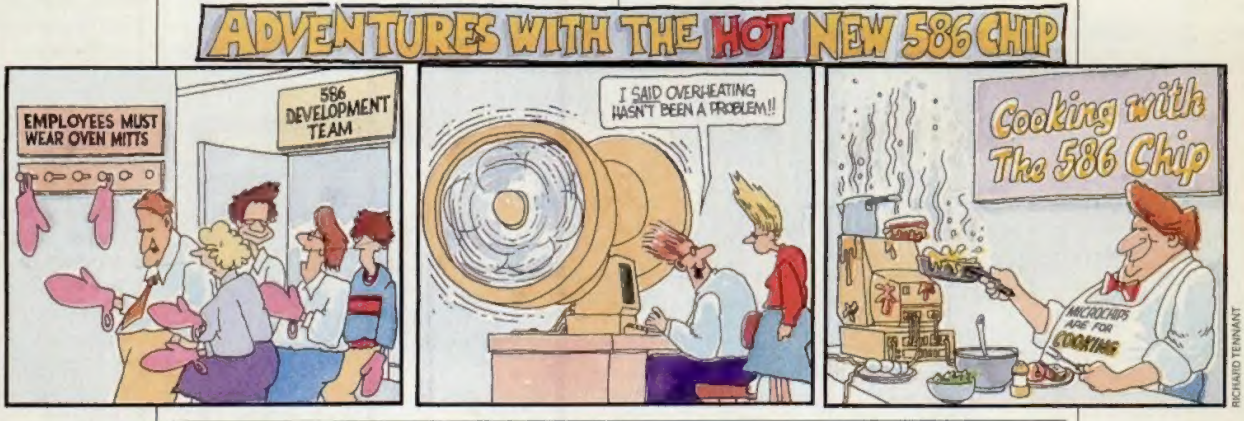
What'll They Think of Next Dept.: LapStrap, from Flat Folding Technologies (515-582-3198), a $49.95 base for your laptop that straps around your leg.

Classified Intelligence:

"**Help wanted**: Dept. of Industrial Accidents, Hearing Stenographer. Hearing Stenographer must be able to produce verbatim transcripts of legal proceeding via stenotype machine. Must be computer compatible . . . ."
—*THE BOSTON SUNDAY GLOBE*, APRIL 26, 1992

"**For sale**: Hard density floppy disk, 35 cents ea. used density, 15 cents ea . . . ."
—*SAN FERNANDO RECYCLER*, APRIL 23–APRIL 29, 1992

"Demo blowout—HP Desk Jet 500 with super font cartridge, $550 WOW! Amdeck 286 with 1 MB ram, 1.2 and 1.44 floppies, 20 MB HD, VGA paperweight monitor, $750 . . . ."
—*OMAHA WORLD-HERALD*, MAY 2, 1992



If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Carle W. Howell (Aztec), Angelo Esposito (computer compatible), Dan Bastecki (hard density floppy disk), David Weis (paperweight monitor).

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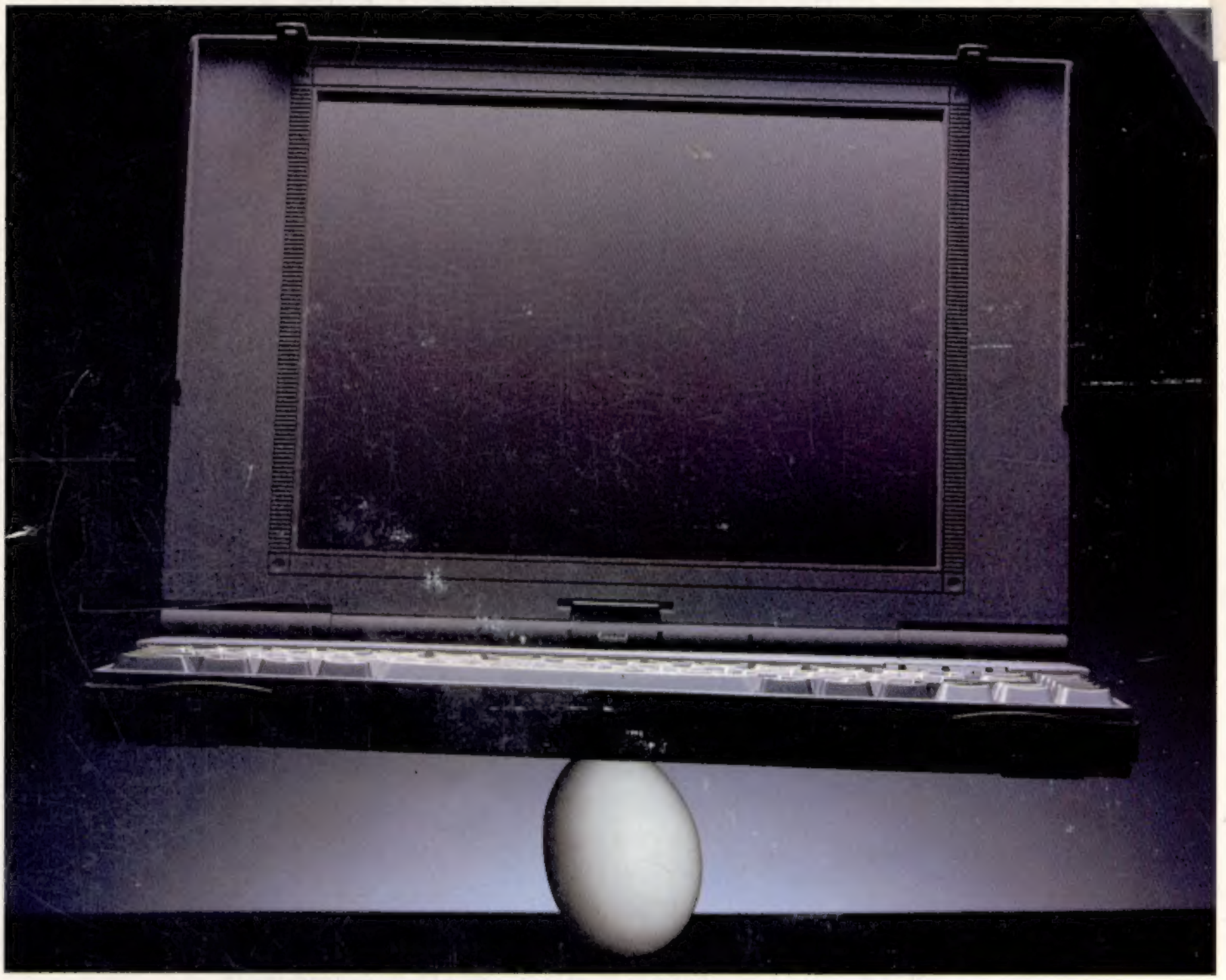

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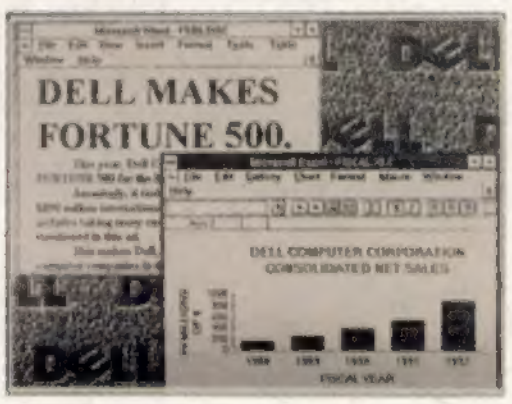

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